GOVDOC
BRA
3780

BOSTON PUBLIC LIBRARY
3 9999 06584 023 1

BOSTON PUBLIC LIBRARY

new container facilities for Massport - a study by CE Maguire, Inc.

T 53
2

Digitized by the Internet Archive
in 2011 with funding from
Boston Public Library

http://www.archive.org/details/newcontainerizat00cema gn 01-653

Marc Older

Property of
[illegible] DEVELOPMENT AUTHORITY
Library

BOSTON
PUBLIC
LIBRARY

NEW CONTAINERIZATION FACILITIES

A FEASIBILITY STUDY

prepared for
THE MASSACHUSETTS PORT AUTHORITY
MPA CONTRACT NO. P-531
by
CE MAGUIRE, INC. — architects - engineers - planners
waltham, massachusetts

Consultants

R. W. Beck and Associates
analytical and consulting engineers
wellesley, massachusetts

R. W. Berry — marine consultant
jamestown, rhode island

NOVEMBER 1973

CONTENTS

INTRODUCTION

ABSTRACT

1. MARKET ANALYSIS 1
   - Introduction
   - General Status and Forecast of Container Traffic
   - Capacity of Existing Facilities
   - Container Activity in the Port of Boston
   - Demand Projections

2. FINDING A LOCATION 53
   - Container Facilities Requirements
   - Navigation
   - Land Transportation Access
   - Environmental Factors
   - Geology
   - The Community
   - Harbor Sites

3. FOUR SITES IN DETAIL 83
   - East Boston Terminal
   - Mystic Wharf
   - Naval Annex and Army Base
   - Castle Island

4. THE NEW TERMINAL 123

APPENDIX 133

Containerizable Commodities
References

INTRODUCTION

An ever expanding demand for containerized shipping over the past few years has taxed the existing terminal facilities in the Port of Boston. As a result, the Massachusetts Port Authority contracted with CE Maguire, Inc. to prepare an econcomic and engineering report evaluating the need and feasibility of constructing additional containerization facilities within the Port. This study was limited to potential sites within the perimeter of the Inner Harbor, from Logan Airport to Castle Island.

The first step in this study was to confirm what was felt intuitively and was shown with each passing month at the relatively new Mystic Public Container Terminal – that there indeed was a need to provide greater capability to handle containerized cargo. Based upon an analysis of the economic factors presently relating to containerization operations in the Port and an evaluation of Boston's market and competition, the magnitude of future container traffic expected to the year 1990 has been projected by R. W. Beck and Associates in conjunction with CE Maguire, Inc. This information provides the basis for the second step – finding the most suitable location for such expansion.

In the site review, the many parameters necessary for evaluating potential sites throughout the Inner Harbor were established. These included factors related to the socio-econcomic aspects of the community, navigation, and ease of access to the highway and rail transportation networks, as well as other site factors of an engineering nature. An inventory was made of all the potential waterfront areas within the Inner Harbor which could even remotely support the additional terminal facilities. After preliminary review of all such sites, the four most promising sites were then more thoroughly analyzed and rated to select that single site most favorable for the development of these facilities.

When the Mystic Terminal was planned and constructed, it was a bold venture undertaken to reverse the trend of a declining port. It was an investment in Boston's future that has proven quite successful; so much so that the crowded storage areas at this new terminal clearly point up the need for expanded facilities. This time the risk is not nearly so great, for the worldwide commitment evident in terms of new terminals and larger container ships underscores the fact that containerization is no passing fancy.

In the course of preparation of this report, the study team met with agencies at the federal, state and local levels to make it known that a report was being prepared. It was determined from these agencies the extent of impacts and constraints which their planning and regulations might have on new port construction and vice versa. Agencies contacted included the following:

Boston Redevelopment Authority
Boston Economic Development and Industrial Commission
Metropolitan Area Planning Council
U. S. Army Corps of Engineers
U. S. Department of the Navy
Massachusetts Bay Transportation Authority
Massachusetts Department of Public Works
M.I.T. Marine Resources Information Center
Chelsea Planning Board
Sea-Land Service, Inc.

In addition to researching the extensive reference data listed in the Appendix of this report, the study team:

Reviewed and discussed the present operating procedures and management techniques with container terminal superintendents.

Made physical inspections of the properties, facilities and equipment of the Massachusetts Port Authority to the extent deemed necessary.

Conducted personal interviews with the Port Director, the Maritime Assistant and other supervising personnel in critical decision-making positions within the Authority.

Interviewed officials from the Maritime Administration in Washington, D.C.; the Massachusetts Department of Commerce; the Port of Baltimore; the Port Authority of New York and New Jersey; the New England Motor Rate Bureau; and the Port of Boston Maritime Association.

Reviewed material received from the ports of Baltimore, New York, New Jersey, Connecticut and Halifax.

Contacted representatives from the Penn-Central Railroad; the Boston & Maine Railroad; Boston and Taunton Transportation Company; M & M Transport Company; Red Star Express; United States Lines; Hemingway Transport; Hartmann Transportation; Schuster Transportation, Inc.; New England Transport; Yale Transport; Arrow Transport; Hi-Way Express Company; Quinn Freight Lines; Intercity Transport Company; and H. P. Welch.

Every attempt was made to integrate the final recommendations of this study with the total community. In this respect, the study does not consider only the economic and engineering feasiblity of a new terminal but directly addresses itself to questions so critial to planning in today's crowded world: what effects will a new terminal have on the people of Boston and how will this construction and subsequent operation affect environmental quality?

We acknowledge the helpfulness of the above agencies. Their interest and forthrightness in providing their comments and background data has made possible a report which hopefully reflects a spirit of mutual cooperation and understanding.

ABSTRACT

Economic projections of future nonpetroleum cargo handled at facilities within the Port of Boston indicate a steadily increasing flow of container traffic into the Port. The existing facilities at the Moran Public Container Terminal are expected to reach optimum capacity by 1976, and additional container handling facilities within the Port will be required to handle the increased growth, projected to reach 271,000 TEU's by 1990.

The Authority must now review its policies to provide adequate facilities for this increase growth.

Of all the areas studied within Boston's Inner Harbor, the site comprising Massport's existing East Boston terminal is the most suitable for developing the required additional facilities to satisfy the projected demand. A portion of the existing Pier No. 1 would be retained to handle future general cargo. Since the proposed terminal would be constructed within property now owned by Massport, there would be no time-consuming delays due to land-taking.

The preliminary cost estimated to totally develop this site to accommodate the projected 1990 demand is approximately $37 million. An additional $2 million is estimated for the conversion of the existing unused railroad spur leading to the site into a truck-rail access route for the sole use of the terminal traffic. Because the design and construction of the terminal is expected to require at least four years, it becomes imperative that the Authority immediately set its future course of action for handling the projected demand beyond 1976. Time lost in these early stages may adversely affect the otherwise orderly growth of container traffic through the Port during the next few years.

1 MARKET ANALYSIS

INTRODUCTION

Containerization has been a major component of water-borne shipping for over a decade and continues to grow in terms of annual traffic volumes and the number of port facilities and specialized vessels being constructed. Given: 1) the increased costs in all elements of the transportation system; 2) the large percentage of general and breakable bulk cargoes which can be containerized; and 3) the fact that containerization can increase ship productivity by a factor of 3 and the productivity of dock labor and resources by a factor of 10, the pressures toward increased containerization become obvious.

The Port of Boston's entry into containerization was relatively recent (1970). Its activities to date have been highly successful as shown by the steady increase in container traffic and tonnage since inception.

Boston has traditionally exhibited relatively high stevedoring costs and this factor has limited its ability to compete with other North Atlantic ports. Increased emphasis on containerization serves to resolve much of this dilemma because it is capital intensive rather than labor intensive. The growth of containerization should enhance Boston's position relative to other ports because of the relative de-emphasis on the cost element in which Boston is least competitive.

While containerization does not yield community benefits in terms of direct waterfront employment, it does provide important economic advantages to the City and State and surrounding regions. Transportation costs, whether for raw materials, component parts or finished products, are ultimately borne by the consumer. Thus, an increase in the proportion of incoming goods and materials which come through the Port of Boston (rather than via a more distant port and a land-haul) lowers the cost to local industries and consumers. Similarly, if the Port can offer efficient shipping opportunities for local industries, the region is in a better competitive position with respect to the attraction and retention of manufacturing and processing industries.

As the utilization of Boston's existing container facilities increases, the Massachusetts Port Authority must consider the point at which these facilities reach their capacity and the important questions relating to the feasibility and possible alternatives for expanding the existing facilities. Given the healthy growth of Boston's container traffic, in the context of a world-wide container climate which focuses on discussions of over-capacity and larger long-term changes in trade routes for container vessels, the Port of Boston must identify its growth options and the factors which make various alternatives viable.

This section of the report focuses on establishing projected demands for container traffic and the translation of these demands into facility requirements. The following chapters start with a description of the general status and the future of container traffic with emphasis on North Atlantic trade, domestic and foreign. The nature and capacity of existing facilities in Boston are then described and related to current and recent container activities in the Port. Future demands and traffic projections are then presented and reconciled with existing facilities to yield a base line for determining and describing expansion needs and strategies.

GENERAL STATUS AND FORECAST OF CONTAINER TRAFFIC

Recent Growth Trends

During the past several years, containerized tonnage of waterborne commerce has grown at a rapid rate, far exceeding the nominal growth for general cargo of about one percent per year. The switch-over to container movements is primarily a function of increases in the "capture ratio," that proportion of containerizable cargoes which are actually shipped via this mode.

Each of the four major northeast ports have exhibited substantial growth in container volumes between 1970 and 1972. Although the container traffic handled in Boston still represents a very small portion of the total Northeast trade, its growth rate far outstrips that of the other ports.

Containerized Tonnage
(in Thousand Short Tons)

	1970	1971	(est.) 1972	% Growth 1970-72
Port of Boston	222	356	458	105
Port of New York	6,448	6,225	7,245	12
Baltimore	1,093	1,375	1,226	12
Hampton Roads	770	1,027	1,143	48

Most of this growth is directly related to overseas trade. The advantageous freight rate structure for land transportation of containers within the domestic market has severly limited traffic in domestic (coastal) waterborne container movements. Statistics on such movements primarily reflect container transfers between a main U.S. port of entry and a "satellite" or feeder port, and generally involves goods with foreign origin/destinations. Boston is an excellent example of such a facility; almost 55% of its 1972 container tonnage was made up of "domestic" feeder operations, with 95% of this traffic involving an ultimate overseas origin/destination.

General Projections

Even though containerization has attained an initial foothold in maritime trade, there are indications that the United States is lagging with respect to realizing the full potential of the containerization concept. A number of factors (the continued split of the U.S. regulatory agencies along modal lines; antitrust consideration; and the imbalance of export versus import container traffic) when taken together serve to discourage the wide-sweeping functional changes which are needed to attain the full potential of containerization.

There is general agreement that world-wide container tonnage will continue to grow substantially over the next several decades. However, the rise in container traffic will not be sufficient to keep pace with the extremely rapid growth of container transport and handling facilities.

A number of factors taken together will create an overall situation of surplus capacity with respect to both container ports and vessels. These factors include an intensive period of capital investment in both vessels and port facilities; a tendency for technological advances to out-pace regulatory and procedural innovations; and the bandwagon effect which capitalizes on national and regional pride. A recent study for the U.S. Maritime Administration suggests that port capacity on the Pacific coast will be running at 570% of demand by 1975. At that time, it is forecast that the Atlantic coast capacity will be at 240% of demand.

This over-capacity results from the inherent efficiencies of present-day container operations. Containerization is a "traffic-hungry" mode of transportation which yields more significant economies at large-scale terminals. This characteristic makes feasible the construction of super containerships with payloads of up to 3,000 containers, and massive terminal complexes such as Sea-Land's Port Elizabeth facility (capable of handling five lanes of container tractors simultaneously at a single berth).

While a significant capacity surplus by 1975 is a matter of general agreement among forecasters, the consequences of this situation can cover a range of "alternate futures."

Competition among both ports and shipping lines with excess capacity will have three significant effects: 1) economic pressures for price competition, 2) revision of existing freight rates, and 3) emphasis on pricing policies which consider the role of marine container movements as part of an integrated transportation system.

These trends are currently reflected in such moves as the establishment of a "mini-bridge" concept for movement of goods between the Far East and the eastern United States and Europe.

The operational cost-effectiveness of high capacity (up to 3,000 TEU's) super containerships requires that their ports of call be limited. These large vessels will have to operate on express schedules, stopping at no more than one or two major ports at each end of a significant trans-ocean leg. The economics of such ship operations indicate that it would be cheaper to transport containerized freight to these express ports, via either land-haul or coastal feeder vessels, than to generate additional stops for the super containerships.

Until the end of this decade, it is expected that the factors of over-capacity, competition and regional pride will create sufficient pressures to prevent major consolidation at only one or two northeast U.S. ports. The implications of this relative to Boston's future in container shipping will be treated in the latter part of this section.

Forecast of Containerization by Trade Route

In 1972, the Port of Boston's container traffic exhibited a capture ratio of almost 52%, i.e., slightly more than half of the cargo suitable for containerization was carried via this mode. This is about the same ratio as the Port of New York and significantly higher than that of the Ports of Baltimore (22%) and Hampton Roads (less than 10%), both of which handle large proportions of bulk cargo considered only marginally suitable for containerization.

Nonpetroleum cargo shipments involving North Atlantic trade routes are not expected to grow significantly over the next decade. Therefore, the key element in Boston's potential with respect to growth in container traffic must place heavy emphasis on the projected growth of the percentage of such cargoes which are containerizable. A significant factor included in this trend is a gradual rise in the proportion of dry cargoes which are deemed suitable for containerization due to technological advances and economic factors. Thus, the growth of future containerization is a joint function of both a rise in the proportion of total dry cargoes which are containerizable and a steadily increasing capture ratio of these cargoes. A detailed analysis of ocean shipping demand by trade route, prepared by the U.S. Department of Transportation, provides estimates for 1973 and 1983 with regard to potential containerizability of cargo and the capture ratio by major trade routes. These forecasts can be summarized as follows:

Essential U.S. Routes	**1973**	**1983**
% Containerizable	83%	84%
% Containerized (Capture Ratio)	28%	50%
Compound % (% of Total via Container)	23%	42%

North Atlantic Routes	**1973**	**1983**
% Containerizable	73%	73%
% Containerized (Capture Ratio)	51%	81%
Compound % (% of Total via Container)	38%	59%

Trade Routes	**1975 Capture Ratio**
No. 1 Atlantic/East So. America	40%
No. 2 Atlantic/West So. America	40%
No. 4 Atlantic/Caribbean	35%
No. 5 North Atlantic/United Kingdom	80%
No. 6 North Atlantic/Scandinavia	65%
No. 7) No. 8) North Atlantic/Western Europe No. 9)	80%
No. 10 North Atlantic/Mediterranean	60%
No. 12 Atlantic/Far East	60%
No. 15 Atlantic/Africa	5%

The rationale used to project the 1975 capture ratios is more fully explained for the key trade routes involving Boston.

Trade Route No. 4, Atlantic/Caribbean: 89% of exports and 79% of imports on this route are potentially containerizable. It is expected that only 35% of this volume will actually be carried on containerships in 1975. The rate of conversion to containers on this route will be slow because (except for Puerto Rico) there is insufficient volume of concentrated containerizable cargo to warrant development of container feeder services on a large scale.

Trade Routes Nos. 5, 7, 8 and 9, North Atlantic/Western Europe: On these routes it is estimated that 85% of exports and 90% of imports are suitable for containerization. Since these are balanced, high volume, competitive routes, and European ports typically have sophisticated container handling facilities, estimates for 1975 indicate that about 80% of the containerizable cargo will move on containterships.

Trade Route No. 12, Atlantic/Far East: Of the cargoes on this route, it is estimated that 41% of exports and 65% of imports are candidates for containerization. Although the Japanese have been among the world's leaders in moving towards containerization, this trade route lacks a two-way balanced volume of containerizable traffic. It is, therefore, estimated that only about 60% of the containerizable volume on this route will actually be containerized over the next few years.

One major uncertainty in all of these forecasts is a possible shift in basic transportation patterns such as the mini-bridge concept, which would involve unit trains to transfer containers between East and West Coast ports. Under this concept, some traffic now moving from Atlantic ports to the Far East by ship will instead cross the United States by train and then continue to the Far East through Pacific ports. Similarly, traffic between Far East and European ports would move by containership to Pacific coast ports, then by train to Atlantic ports, and finally via containership to European destinations. If this concept comes into significant usage, Atlantic ports would lose some of the projected cargo on the Atlantic to Far East route, but would gain traffic on the trans-Atlantic route. The net effect on Atlantic ports should not be more than one or two percent in either direction.

CAPACITY OF EXISTING FACILITIES

Introduction

Specialized facilities for handling Boston's container traffic are located at the J. F. Moran Docks (Mystic Public Container Terminal) and at the Sea-Land Terminal at Castle Island. These locations handled 87% of the total number of containers which passed through the Port in 1972. The remaining container traffic was handled at other locations in the Port of Boston and consisted primarily of small numbers of containers carried as deck cargo on break-bulk vessels. Projections indicate that, as container traffic increases, the percentage of containers handled outside of the Sea-Land and Moran facilities will be minimal (5% plus or minus).

Measurement of Capacity

The methodology for determining maximum capacity for a container handling area must consider many factors. The key variables include: the size and number of berths; the maximum draft depth; the number, type and capacity of cranes; the size and configuration of the storage area; the distances among the berths, storage areas and rail or truck facilities; and the length and number of rail sidings and truck terminal facilites. The capacity calculations based on these variables must also consider the time distribution of ship arrivals, the availability and characteristics of the local labor force, pertinent weather factors, etc.

With respect to the Boston facilities, the major parameters which establish the current capacity of the two existing container terminals are the size of inland storage areas and shipping schedules.

Castle Island

The Castle Island Container Terminal, located in South Boston, is leased by the Port Authority to Sea-Land Service, Inc., a private corporation, under a lease which runs until 1991. It is used by Sea-Land to provide once-per-week feeder service between Boston and the firm's large container terminal at Port Elizabeth (part of the Port of New York).

The present facility provides ground space for 275 of the 35-foot containers used by Sea-Land. Since these containers are transported on chassis and cannot be stacked, available ground space becomes the key limiting factor. Capacity is related to the potential turn-over rate of these spaces. The fact that Sea-Land has direct control over its own vessels' sailing schedules and the container flow between Boston and points of origin/destination, permits highly efficient use of storage space and maximum turn-over.

Given the existing storage acreage and assuming that 250 of the spaces can be turned over for each vessel arrival,* the terminal's capacity is 500 containers per vessel arrival. Based on the current weekly schedule, this translates into a capacity of 26,000 containers annually. Allowing for seasonal traffic fluctuations, poor weather and other circumstances, a capacity of 20,000 containers per year is a realistic ceiling for the current facility and schedule. Based on the 35-foot container used by Sea-Land, this translates into 35,000 TEU's per year.

However, these figures do not reflect the true capacity of the Sea-Land terminal. If traffic demand warranted an increase in capacity, the present facility could sustain up to twice the tonnage. Based on crane capacity (25 containers per hour and 20 hours per vessel arrival) and time in port (2+ days per vessel without overtime), the terminal could readily handle a twice-weekly sailing schedule.

For purposes of this report, the capacity of the Castle Island container facility (under control of a single operator), therefore, must be considered to be 70,000 TEU's per year.

The economics of such a move for Sea-Land are outside the immediate scope of this study; here the focus is only on establishing the capacity ceiling of the facility. Various questions, such as additional vessel requirements, overtime labor impacts and net revenue fluctuations during the transition period (i.e., when traffic exceeds the capacity of a single vessel per week but is insufficient for profitable operation of twice-a-week service) would have to be examined by Sea-Land management at the appropriate time.

---

*It is recognized that the turn-over rate used in the above calculation is high and represents a most efficient operation. This efficiency is possible because of Sea-Land's mode and scale of operation on a worldwide basis and the degree of control it can exercise over its cargo movements. It would not be realistic to expect a public terminal or a more limited private shipper to turn over 90% of the available container storage slots at every vessel arrival.

J. F. Moran Docks (Mystic Terminal)

The Moran Docks are Boston's newest containerization facility, having begun operation in September 1971. Located at the Mystic Pier Terminal in Charlestown, the Moran facility is equipped with a 70-ton capacity Hitachi crane and a 46-ton capacity Paceco crane. The container handling capabilities of these two cranes appear to be more than adequate to handle the traffic at this 22-acre site. The capacity of the Moran Docks is currently constrained by the limited amount of storage space in the area.

The facility currently has 684 container storage slots at ground level. Since the containers shipped through this terminal typically are not mounted on chassis, it is theoretically possible to triple-stack containers and provide a maximum storage capacity of some 2,000 containers. However, accessibility constraints and a configuration which does not lend itself to efficient traffic flow yields a practical storage capacity of some 1,400 TEU's.

Given that the average turnover per container in a public terminal approximates one per working week (i.e., 52 turnovers per year), the present storage capacity should theoretically approximate 72,000 TEU's per year. Introduction of factors which reduce the level of activity below this ceiling (e.g., seasonal fluctuations in traffic volumes, weather conditions, etc.) indicate that the expected throughput capacity of the Moran Dock will approximate 60,000 TEU's. This ceiling is consistent with generally established guidelines for container facilites consisting of one berth and 20-25 acres of storage capacity. Although the Moran Dock is a two-berth facility in terms of pier length and crane capacity, severe limitations on available storage space restrict its operation to the equivalent of a single-berth terminal.

Container Capacities at Other Port Locations

In addition to the Moran Docks and Sea-Land's Castle Island facility, there are other facilities within the Port of Boston at which containers are handled. In 1972, these included: Mystic Pier No. 1; the Port Authority's own Castle Island facility; the Army Base in South Boston; and East Boston Pier No. 1. The capability of these sites to handle containers is limited by their lack of the proper equipment and has been further reduced by the change in operation at Mystic Pier which handled a large number of containers in 1971. Therefore, it has been assumed that the number of containers these locations will handle in the future will remain minimal. For the purpose of this report, we have assumed the capacity for handling containers at these other Port locations is approximately equal to actual historical movement through these areas, a maximum level of 10,000 TEU's annually.

Total Present Container Capacity

Utilizing the figures developed above, the theoretical annual maximum container handling capacity of the present Boston facilities is 140,000 TEU's comprised of the following:

Moran Docks	60,000 TEU's
Sea-Land	70,000 TEU's
Others	10,000 TEU's
TOTAL	**140,000 TEU's**

CONTAINER ACTIVITY IN THE PORT OF BOSTON
1970 – 1973

The nature and characteristics of container-related activity within the Port since the start-up of specialized container handling facilities in mid-1970 is described in this section. Special emphasis is placed on the year 1972, not only because it represents the most recent full year, but also because it is the only true representation of normal port functioning. The Moran Dock did not begin operation until the last quarter of 1971, and the statistics for that year are further perturbed by the 2-month longshoreman strike. 1972 data, and where possible 1973 estimates based on the first seven months' operating records, are used as the major points of departure.

It is generally agreed that fuel products, such as petroleum derivatives and liquid natural gas, are totally unsuitable for containerization. Such products have, therefore, been eliminated from the following analysis. They are not only irrelevant but the sheer magnitude of fuel tonnages in relation to total traffic only serve to obscure trends and relationships in the nonfuel category.

Port of Boston — Growth of Nonfuel and Containerizable Cargo

Year	Total Traffic	Total Nonfuel Cargo	Total Containerizable Cargo	Annual Growth Rate	% of Nonfuel Cargo Which Is Containerizable
1967	21,549,108	2,826,827	775,131		27.4%
1968	22,610,760	2,805,851	768,488		27.4%
1969	24,818,746	2,620,901	603,547		23.0%
				21.6%	
1970	26,867,918	2,897,303	733,995		25.3%
				6.1%	
1971	26,156,517	2,922,545	778,578		26.6%
				13.7%	
1972	26,483,438	2,972,631	885,100		29.8%
				13.0%	
1973*	N/A	3,000,000	1,000,000		33.0%
1967—73 Growth		6.1%	29%		

---

* All 1973 entries are estimated on basis of first seven months of 1973.

Growth of Nonpetroleum and Containerizable Cargo

The recent history of the Port of Boston with respect to total traffic, nonfuel cargo and containerizable cargo is shown. These data indicate that, while total traffic in the Port has grown at a reasonable rate between 1967 and 1972, nonfuel cargoes have been relatively stagnant with respect to volume, growing at approximately 1% per year.

This total nonfuel cargo includes both general cargo and bulk commodities. The traffic of interest from a container standpoint is the proportion of this nonfuel cargo which is suitable for shipment via containers. Different commodities, by virtue of their configuration, size, state or value represent prime candidates for containterization; others are marginal or even totally unsuitable for shipment by this means. The Port of New York Authority has developed a categorization of commodities with respect to suitability for containerization (see Appendix), and this technique was used to determine the proportion of nonfuel cargo in each year which can be considered as potentially containerizable. Containerizable cargo has grown at a greater rate than total nonfuel cargo as shown. This is especially true in the last two years when such containerizable cargo exhibited an extremely robust growth rate of 13% per year. At the present time, some one-third of total nonfuel traffic in the Port of Boston is judged as suitable for containerization.

Port of Boston — Growth of Containerizable Cargo and Container Tonnage

Year	Total Containerizable Cargo	Tons Containerized	Annual Growth	% Containerizable Via Container	Number of Containers (TEU's)	Annual Growth
1967	775,131	N/A		N/A	N/A	
1968	768,488	N/A		N/A	N/A	
1969	603,547	17,934		3.0%	2,135	
1970	733,995	222,264		30.3%	26,460	
			60.3%			60.5%
1971	778,578	356,318		45.8%	42,472	
			28.5%			40.3%
1972	885,100	457,800		51.7%	59,642	
			26.7%			34.2%
1973*	1,000,000	580,000		58.0%	80,000	

* All 1973 entries are estimated on basis of first seven months of 1973.

Containerized Traffic

As shown in the table, container traffic passing through the Port has increased at a very substantial rate since 1970 when significant container-handling facilities were first made available in Boston. As might be expected, the annual growth percentage with respect to both containerized tonnage and the number of TEU's is beginning to decelerate. This is no doubt due to the initially heavy influx of container cargoes which are generated in the immediate Boston area but which had to be shipped via other ports prior to 1970. The heavy influx of such "captive" cargoes when the facilities were first opened caused an initial surge in tonnage which is now beginning to level off.

An extremely healthy sign with respect to Boston's viability as a container port is the continuing increase in the proportion of containerizable cargo which is actually "captured" for shipment via this mode. The growth in containerized traffic volume is thus a function of an increase in both 1) the proportion of cargo suitable for containerization and 2) the proportion of this potential actually converted to container traffic.

Number of Containers Handled by the Port of Boston — 1971

	Sea-Land	Moran Docks	Others	Total
Inward	7,981	802	13,921	22,704
Outward	6,549	348	12,871	19,768
Total	14,530	1,150*	26,792	42,472
Percent of Total	34.2%	2.7%	63.1%	100%

*Began Operations September 1971.

1972

Inward	19,863	10,747	4,555	35,165
Outward	11,110	9,851	3,516	24,477
Total	30,973	20,598	8,071	59,642
Percent of Total	51.9%	35.1%	13%	100%

1973

Inward	N/A	21,000	5,100	N/A
Outward	N/A	18,500	3,900	N/A
Total	31,500	39,500	9,000	80,000
Percent of Total	39.4%	49.4%	11.2%	100%

Source: Data provided by the Mass Port Authority.

Number of Containers (TEU's) Handled

The number of TEU's handled in the Port during 1971–1972 are set forth in the table as a function of both facility and direction of flow. These data illustrate both the substantial growth of the domestic feeder service at Sea-Land and rapid rate at which the specialized Moran container facility has been able to absorb the international container traffic, which was previously handled at other port locations lacking the special facilities for efficient container operation. Some container traffic will always flow through these other facilities, primarily in small volumes as deck cargo on bulk or break-bulk freighters. Preliminary estimates indicate that by 1973 about 11% of the total number of containers will be handled outside of the Sea-Land or Moran facilities.

These data also show a moderate, but not unexpected, imbalance in container flow with respect to inbound versus outbound traffic. The imbalance is far smaller than the comparable imbalance in general cargo tonnage, reflecting the need for two-way flows of cargo in order to make a container port viable. Primarily as a result of this imbalance, some 20% of the total TEU's handled in 1972 were empty containers, mostly outbound. Preliminary statistics for the first seven months of 1973 indicate a drop in the percentage of empties shipped, to a level slightly in excess of 15%.

Vessel Arrivals

The number of fully containerized cargo vessels arriving in the Port of Boston each year since container facilities were installed is as follows:

1970	1971	1972	1973 (est.)
46	74	163	247

The increase in this arrival rate is especially significant in view of the statistics relating to other types of vessels during the comparable period. The number of bulk carriers increased only slightly from 225 to 240 while the number of tankers decreased from 755 to 661 (a drop which reflects increased cargo capacity per vessel rather than a decline in tanker tonnage). Containerization has taken a sufficiently firm foot-hold in Boston to cause a drop in break-bulk cargo vessel arrivals, from 718 to 442 during the period. Of the 163 container vessel arrivals during 1972, 46 docked at the Sea-Land Terminal, 112 at the Moran Docks and the remainder at other port facilities. A breakdown of the 1973 points of arrival for containerships is not yet available, but it appears that Moran Docks will handle between 180 and 190 arrivals, with almost all of the remainder going to Sea-Land.

During 1972, each vessel arrival at Sea-Land generated an average of some 670 TEU movements (off-loadings plus on-loadings). The comparable figure per vessel arriving at the Moran Docks was 188 TEU movements. The difference between these figures reflects the disparate nature of the operation at these two terminals. Sea-Land operates as a point-to-point feeder terminal and has the flexibility of scheduling its own vessels at a frequency which insures an adequate load factor. The Moran Dock, as a public terminal, typically serves as one of several ports of call for a given vessel, resulting in only partial turn-over of each vessel's load.

Dollar Value per Ton – Nonfuel Cargo (Foreign Trade)

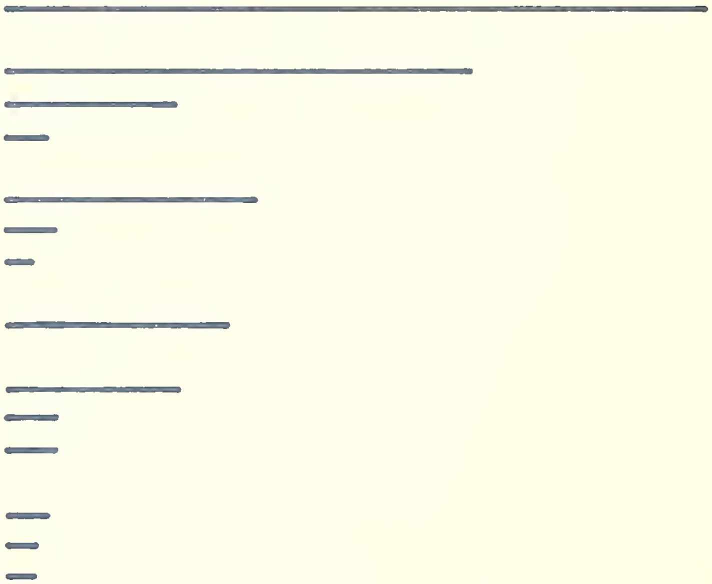
	May 1973	1972	1971	1970	1970–72 Growth
All Districts					
Exports	137.60	120.00	115.40	106.60	+ 13%
Imports	233.80	219.40	175.60	163.80	+ 34%
North Atlantic (U.S.)					
Exports	217.00	188.60	179.00	151.00	+ 25%
Imports	357.20	307.00	242.20	229.80	+ 34%
Boston					
Exports	246.80	211.80	202.80	163.20	+ 30%
Imports	484.20	395.40	316.00	350.20	+ 13%
Providence					
Exports	37.40	30.60	28.20	46.80	– 35%
Imports	354.40	171.20	48.40	48.80	350%
New York					
Exports	959.40	1,118.60	1,046.60	990.20	+ 13%
Exports	904.20	797.00	677.20	644.60	+ 24%
Philadelphia					
Exports	148.00	185.40	221.10	189.20	– 2%
Imports	80.20	83.60	63.80	65.20	+ 28%
Baltimore					
Exports	231.80	176.40	172.80	133.00	+ 33%
Imports	205.80	132.20	107.80	85.00	+ 56%

Value Per Ton of Nonfuel Cargo

Because of the security, protection and speed associated with container shipments, this mode tends to attract the relatively high-valued cargoes as a primary market. The dollar value per ton of dry cargo for Boston, both historically and in relation to other North Atlantic trade, is set forth in the table. These data indicate that with respect to both exports and imports, Boston's dollar value per ton is higher than the total U.S. and North Atlantic figures, and higher than that of any individual port other than New York. This relationship has been true almost consistently since 1970 and appears to be improving even further as of May 1973. These dollar values reflect the importance of machinery, manufactured products and similar commodities in New England's regional economy; a situation conducive to a solid market for containter traffic.

Port of Boston — Nonfuel Tonnage 1972

	TRADE CATEGORY	PERCENTAGE OF TOTAL TRADE
1.	**TOTAL FOREIGN TRADE**	77
	Total Imports	52
	Imports Containerizable	17
	Imports Containerized	4
	Total Exports	25
	Exports Containerizable	5
	Exports Containerized	2
2.	**TOTAL DOMESTIC TRADE**	23
	Total Receipts	19
	Receipts Containerizable	5
	Receipts Containerized	5
	Total Shipments	4
	Shipments Containerizable	3
	Shipments Containerized	3
	TOTAL TRADE 1 + 2	100%

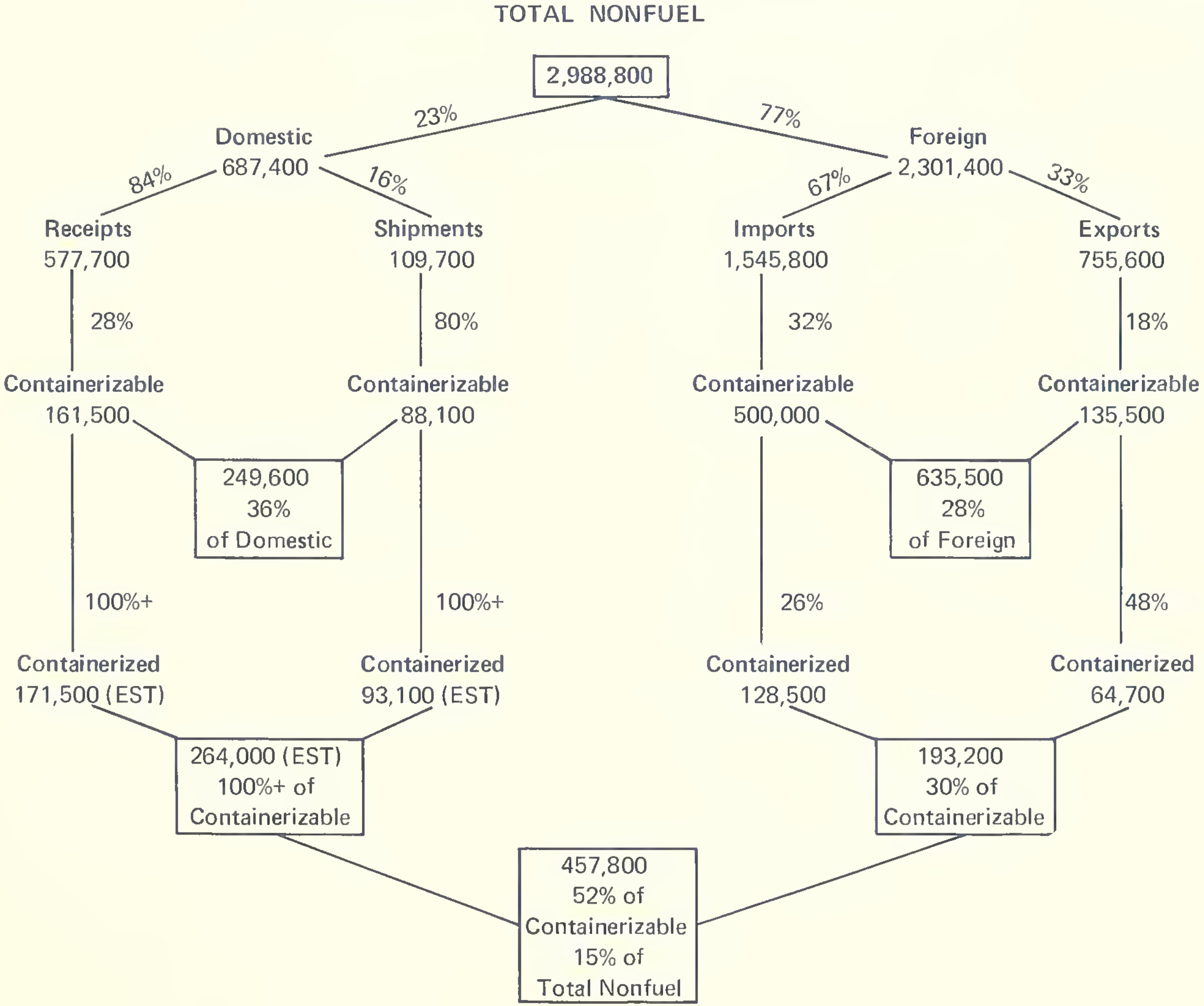


Containerization of Nonfuel Tonnage by Direction and Origin/Destination

Earlier, the Port's dry cargo traffic was analyzed in terms of suitability for containerization and capture ratio (see table). However, as a prelude to projection of future container potential, it is necessary to examine these total tonnages in finer detail. In view of the differences in operation between the Sea-Land and Moran terminals, traffic data were first divided into domestic (coastal) and foreign trade. Each of these was then analyzed separately, in terms of the direction of flow; the percentage of cargoes judged to be suitable for containerization; and the percentage actually shipped via container in 1972. The results are as shown. The bar chart provides a graphic presentation of the various market segments while the flow diagram provides detailed numbers and percentages.

First, let us consider domestic traffic which shows that incoming tonnage exceeds outgoing shipment by better than 5 to 1. However, a significant portion of this incoming cargo is made up of bulk commodities, most of which are not suitable for containerization. Therefore, with respect to containerizable cargo, the proportion of incoming to outgoing traffic is slightly less than 2 to 1. Taken together, slightly more than one-third of the coastal cargo moving through the Port of Boston in 1972 was suitable for containerization, and all of this potential was captured by the Sea-Land Terminal.

Port of Boston — Categorization of Nonfuel Tonnage 1972



Port of Boston — Tons of General Cargo in Foreign Trade

	IMPORTS					EXPORTS				
	1971		1972			1971		1972		
	Share of Imports	Tonnage	Share of Imports	Tonnage	Change (71–72)	Share of Exports	Tonnage	Share of Exports	Tonnage	Change (71–72)
North America	13%	85,021	14%	95,311	12%	0%	22	3%	2,587	*
South America	4%	29,105	3%	21,923	(–25%)	3%	1,816	1%	918	(–49%)
Europe	42%	271, 561	42%	275,873	2%	58%	40,727	66%	58,662	44%
Asia	31%	203,174	34%	223,152	10%	30%	21,198	24%	21,318	.5%
Africa	2%	13,861	2%	13,021	(–6%)	2%	1,631	2%	1,348	(–17%)
Australia	7%	47,617	5%	29,880	(–37%)	7%	4,538	5%	4,459	(–2%)
TOTAL		652,512		659,160	1%		69,743		89,292	28%

	1971	1972	% Change (71–72)
Total Tonnage	722,255	748,452	3.6%

Containerization of Nonfuel Tonnage by Direction and Origin/Destination (Continued)

With respect to foreign cargoes, which constituted some 3/4 of the total nonfuel traffic in the Port, the picture is quite different. Incoming tonnage also exceeded exports but only by a factor of 2 to I. The same ratio held true with respect to tonnage actually shipped by container. Imports represented a higher proportion of goods suitable for containerization but with a relatively low capture percentage. Exports, on the other hand, were less suitable for containerization (primarily because of the large proportion of scrap metal, a commodity not suited for containterization), but almost half of the suitable cargo was shipped via container. Taken together almost one-third of the containerizable foreign trade tonnage was shipped via this mode in 1972.

The origin and destination of these foreign trade cargoes for 1972 and 1971 were examined, and the results are shown in the table. Major origins of Boston's import traffic were Europe (especially United Kingdom, Belgium and Germany) and Asia (primarily Japan). Neither the total volume of import tonnage nor the distribution by continent of origin changed significantly between 1971 and 1972. The volume of exports during that period grew by a significant percentage (but on a relatively low volume base). The primary destinations of Boston's cargo exports were, again, Europe and Asia. The substantial increase in exports to Europe accounted for virtually all of the growth in the Port's export trade during 1972, with the biggest increases being shipments to the Netherlands and Italy.

Current Activity versus Capacity

Castle Island

As discussed earlier, the facility's capacity is determined by the number of containers handled and the frequency of vessel arrivals. The 1972 traffic of 31,000 TEU's (17,700 of the 35-foot long containers used by Sea-Land) constitutes 90% of the 35,000 TEU annual volume which is considered to be the terminal's practical capacity for a weekly sailing schedule. In terms of the average number of TEU movements per containership arrival, the 1972 figure (670) represents 77% of the practical capacity, which is considered to be 875 TEU's.

Although 1973 figures for Sea-Land's container volume are not yet available, the total is expected to remain fairly stable at 31,500 TEU's. The slight increase will relate to several additional vessel arrivals rather than to any major increases in the number of container movements per arrival. Overall, the terminal is operating (1973) at about 46% of its practical capacity.

Moran Docks

The practical operational ceiling of the present Moran facility is calculated to be a volume of 60,000 TEU's annually. The estimated 1973 traffic through this facility will approximate 40,000 TEU's and thus reach two-thirds of the terminal's practical capacity.

DEMAND PROJECTIONS

The need for and feasibility of additional container facilities in the Port of Boston depends primarily on projections of the container traffic which would flow through the Port if new facilities were provided.

The most important factors to be considered in evaluating the ability of incremental traffic growth to support expansion include the following:

Present and projected container traffic.

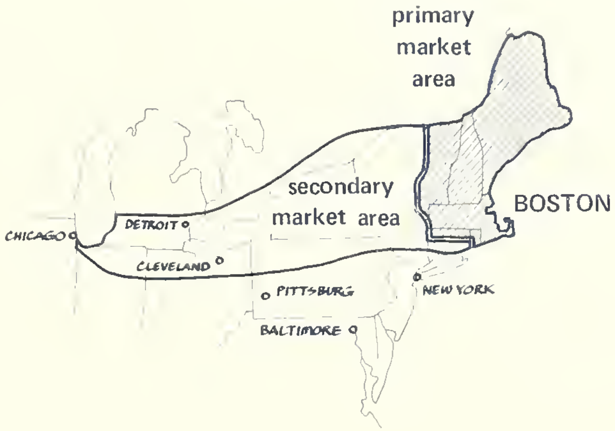
The capacity and degree of utilization of existing facilities.

The possible sources of new container traffic and the confidence level with which projections from each source can be made.

The point at which the existing capacity will be exhausted.

The time frame during which new facilities will reach a viable level of traffic.

The regional consequences inherent in failure to adequately service increased demand (e.g., lost revenues, higher prices to consumers, loss of local and regional industry, etc.).



Boston: Primary and Secondary Market Areas

Sources of Increased Demand

The potential sources of increased container traffic through the Port of Boston are:

Growth — The most straight-forward source of additional demand will come from the basic growth rate of those commodities and materials already moving through the Port via containers. This growth will result from factors such as increases in receipts and shipments by area manufacturers and in consumer demand for imported goods. Expansion in this segment of container trade may fluctuate as a function of international trade conditions (e.g., the relative value of the dollar versus foreign currencies and the U.S. balance of payments, etc.). A basic assumption in projecting increased growth is that current traffic levels will not be eroded by competition from other ports or modes of transit. Taking all these factors together, a basic growth estimate of one percent per year in nonfuel cargo is taken for the Port of Boston.

Conversion — Added container demand will result from two types of conversion. The first is an increase in the percentage of nonpetroleum cargo which because of technological advances in shipping and packaging becomes suitable for containerization. The estimated 1973 percentage for Boston is 33%, based on those commodities being handled through the Port. Comparison of this percentage with recent growth in both Boston and other Northeast ports, and with general marine trade predictions for this region, yields a projected growth rate of two percent per year through 1980 and a one percent increment from 1981-1990.

A second percentage factor involved in establishing conversion-based demand has been termed the "capture ratio," the percentage of containerizable tonnage which is actually moved by container. The growth rate of this ratio has likewise been calculated on recent Boston experience and forecasts for other ports and North Atlantic trade routes. The capture ratio is expected to grow at a rate of two percent per year through the end of the present decade, at one percent per year through 1985, and at 0.5 percent per year from 1985-1990.

Recapture — Containerizable cargo with points of origin or destination within Boston's primary market area (see Figure) is currently being shipped via other ports. As Boston's container facilities expand with respect to capacity, efficiency and shipping schedules, it is reasonable to expect that some of this traffic, considered to be within Boston's "natural" market, can be added to the Port's volume. Existing evidence indicates that an estimated 75% of the exports from Boston's prime market area are being shipped through the Port of New York and that Boston is losing on the order of 1,200,000 tons of manufactured cargo annually to other ports. If only half of this traffic could be recaptured by Boston, for either direct shipment overseas or via waterborne feeder operation to New York, this would represent a potential of some 500,000 tons of containerizable cargo per year.

Attraction from Secondary Market — Studies have indicated that Boston is obtaining less than 0.5% of the containerizable exports from its secondary market area (i.e., geographic locations where land-haul rates to Boston are equivalent to those for New York, see Figure). The massive volume of

Container Traffic and Facility Projections-Foreign Trade Only

Year	Containerizable Foreign Trade Tonnage	Annual Growth	% Containerized	Containerized Tonnage	No. Full Containers	Total No. Containers	Facilities Required
1973 (est.)	740,000	17%	32	237,000	30,000	34,500	43,100
1974	814,800	10%	34	277,800	33,000	37,900	47,400
1975	896,300	10%	36	322,700	38,400	44,200	55,200
1976	923,200	3%	38	350,800	41,800	48,000	60,000
1977	950,900	3%	40	380,400	45,300	52,100	65,100
1978	969,900	2%	42	407,400	48,500	55,800	69,700
1979	979,600	1%	44	431,000	51,300	59,000	73,800
1980	989,400	1%	45				
1981	999,300	1%	46				
1982	1,009,300	1%	47	474,400	56,500	64,900	81,200
1983	1,019,400	1%	48				
1984	1,029,600	1%	49				
1985	1,039,900	1%	50				
1986	1,050,300	1%	50.5	530,400	63,100	72,600	90,800
1987	1,060,800	1%	51				
1988	1,071,400	1%	51.5				
1989	1,082,100	1%	52				
1990	1,092,900	1%	52.5	573,800	68,300	78,600	98,200

cargo shipments from/to this secondary region makes it a most attractive marketing target. However, because of heightened competition due to the regional surplus capacity squeeze, the difficulty of demonstrating any substantial advantage of Boston with respect to land transportation, and the inertia inherent in maintaining existing patterns of operation, it seems unlikely that Boston can attract any appreciable cargo traffic currently moving to New York from the Mid-West. On the other hand, it may be possible for Boston to capture a small percentage (five percent plus or minus) of the new containerizable foreign traffic being forecast for New York. This traffic volume represents the most speculative element, as regards possible sources of increased traffic for Boston.

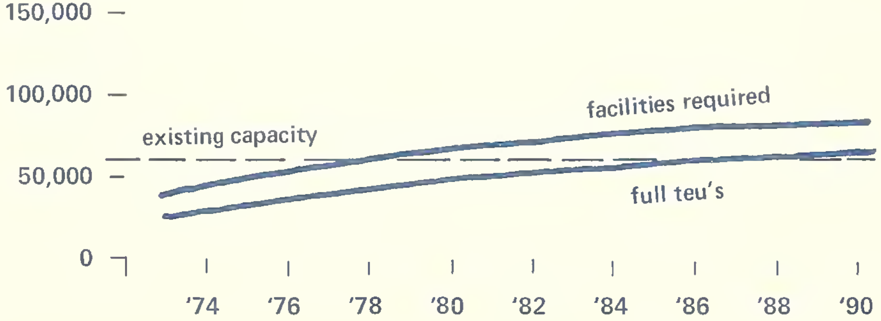
Range of Projected Demand

It is possible to weight the potential sources of increased container traffic for Boston in a number of combinations to yield a wide range of projected facility requirements for 1980 and 1990. As discussed below, the 1990 container facility needs can be projected at anywhere from 98,000 TEU's to almost 360,000 TEU's of annual capacity.

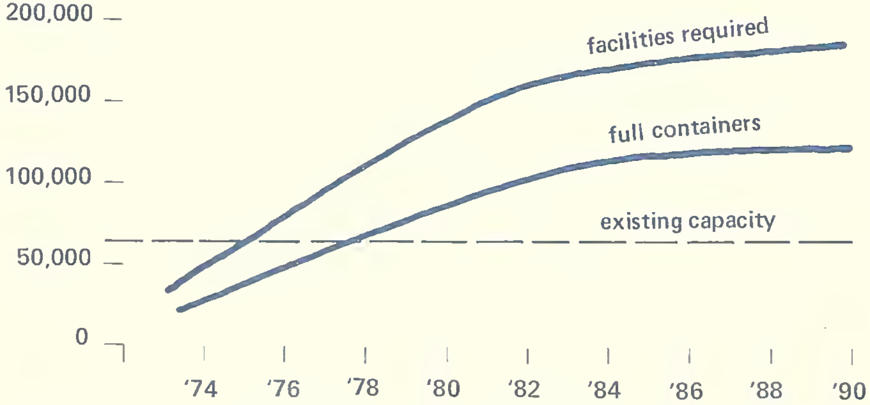
Foreign Trade Growth Only

The lower bound on projected demand is based on a conservative forecast of long-range growth of existing foreign container traffic **only**. If the rapid recent growth in containerizable foreign tonnage is projected to moderate by 1975 and the capture ratio (percent containerized) is allowed to increase gradually, the results are as shown in the Table and depicted graphically. This assumes no major recapture of the million or so tons of Boston exports which currently are shipped via other ports. The facility requirements shown in this Table have been determined as follows: The number of full containers is obtained from the containerized tonnage estimated on the basis of 8.4 tons per TEU (the current Boston average). The number of full containers is then increased by 15% to reflect for empty container shipments, and this total is increased by a 25% allowance for peaking to determine total facilities required.

The resulting projection of 98,000 TEU's per year by 1990 would cover the condition in which all domestic traffic would continue to be handled solely by Sea-Land, and that Sea-Land would not exceed the capacity of their current terminal facilities. If Sea-Land were not to expand, but were to use land-haul transport for container traffic in excess of its current terminal's capacity, the Port of Boston growth would be limited to growth in foreign trade only.



Container Traffic & Facility Projections Basic Foreign Trade



Container Traffic & Facility Projections Foreign Trade Growth + Major Recapture of Primary Market

Basic Foreign Trade Plus Major Capture of Exports From Primary Market Area

A long-range demand can also be forecast on the basis of increase in the basic foreign trade growth described above plus a recapturing of a major portion (50%) of the containerizable traffic from the primary market area which now moves through other ports. The resulting growth projection indicates a level of 184,000 TEU's by 1990.

Projected Container Tonnage — Basic Domestic Feeder + Foreign Trade

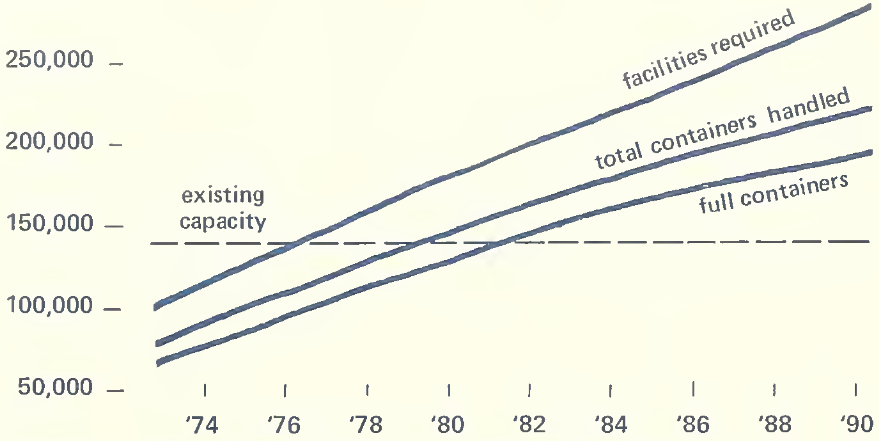
Year	Total Nonpetroleum	% Containerizable	Containerizable Tonnage	% Containerized	Containerized Tonnage	Compound %
1973	3,000,000	33%	1,000,000	58%	580,000	19.1%
1974	3,030,000	35%	1,060,500	60%	636,300	21.0%
1975	3,060,300	37%	1,132,300	62%	702,000	22.9%
1976	3,091,000	39%	1,205,500	64%	771,500	25.0%
1977	3,121,800	41%	1,279,900	66%	844,800	27.1%
1978	3,153,000	43%	1,355,800	68%	921,900	29.2%
1979	3,184,600	45%	1,433,100	70%	1,003,100	31.5%
1980	3,216,400	47%	1,517,800	71%	1,073,300	33.4%
1981	3,248,600	48%	1,559,300	72%	1,122,700	34.6%
1982	3,281,100	49%	1,607,700	73%	1,173,600	35.8%
1983	3,313,900	50%	1,657,000	74%	1,226,100	37.0%
1984	3,347,000	51%	1,707,000	75%	1,280,200	38.3%
1985	3,380,500	52%	1,757,900	76%	1,336,000	39.5%
1986	3,414,300	53%	1,809,600	76.5%	1,384,300	40.5%
1987	3,448,400	54%	1,862,100	77%	1,433,800	41.6%
1988	3,482,900	55%	1,915,600	77.5%	1,484,500	42.6%
1989	3,517,700	56%	1,969,900	78%	1,536,500	43.7%
1990	3,552,900	57%	2,025,200	78.5%	1,589,700	44.7%

Projected Container Facility Requirements
Basic Domestic Feeder + Foreign Trade

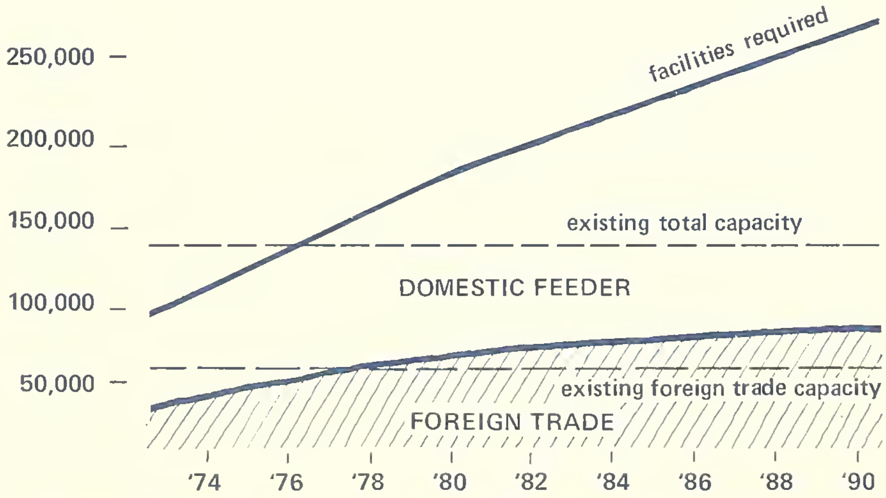
Year	Containerized Tonnage	Number of Full Containers	Total Containers Handled	Facilities Required
1973	580,000	69,600	80,000	100,000
1974	636,300	76,000	87,400	110,000
1976	771,500	92,000	105,800	132,000
1978	921,900	109,000	125,400	156,000
1980	1,073,300	128,000	148,200	185,000
1982	1,173,600	140,000	161,000	201,300
1984	1,280,200	153,000	176,000	220,000
1986	1,384,300	165,000	189,700	236,400
1988	1,484,500	179,000	207,000	259,000
1990	1,589,700	189,000	217,400	271,300

Increases in Basic Domestic and Foreign Tonnage

The impact of growth and conversion on current domestic and foreign containerizable tonnage is set forth in the Tables and shown graphically. This assumes a one percent growth in total nonpetroleum cargoes and increases in present containerizable percentages and capture ratios which are consistent with North Atlantic Region trade projections. The resulting requirement for facilities to handle some 271,000 TEU's per year (by 1990) do not reflect major capture from the Prime Market Area nor any attraction of cargo from the Secondary Market Area. The conversion for containerized tonnage to facility requirements employs the same rationale as that discussed above.



Container Traffic & Facility Projections Domestic Feeder + Foreign Trade



Projected Facility Requirements Foreign & Domestic Service

Maximum Growth Projection

If one were to assume that growth and conversion of both foreign and domestic traffic would be coupled with major recapture from the Prime Market Area plus the addition of even a small percentage of increased traffic from the Secondary Market Area, the facility requirement projection would rise to some 360,000 TEU's by 1990. While it is felt that this number is unrealistic and represents a level of optimism unjustified by the existing or future condition of the container industry in the North Atlantic, it is provided as a point of reference.

The various combinations of cargo sources upon which traffic can be forecast and the resulting facility requirements in TEU's can be summarised are as follows:

Source	Facility Requirements 1980	Facility Requirements 1990
Basic Foreign Trade Only	76,300	98,200
Basic Foreign Trade Plus Recapture of Prime Market	148,100	184,400
Growth and Conversion Domestic and Foreign	185,000	271,300
Domestic and Foreign Plus Major Recapture	266,900	360,000

CONCLUSIONS

All of the above projections indicate that facility requirements will exceed existing capacity by about 1976. With respect to creation of new or expanded facilites, the primary question concerns the size of facility to be considered and the time frame within which the added capacity will be sufficiently utilized to make it economically viable. A modern container berth with sufficient acreage (25 acres plus or minus) can operate efficiently at a level of shipment of 50,000 TEU containers per year.

It appears that if Massport were to rely solely on foreign trade cargo growth and conversion, without major recapture from within Prime Market Area, and not give any consideration to expansion of domestic feeder service beyond Sea-Lands's present facility, an additional berth would be required by about 1976. However, this berth would not operate at an efficient traffic volume until sometime after the year 2000. Under such circumstances the Port Authority's best strategy would be to place the highest priority on expansion of the storage acreage at the Moran Terminal. If it were possible to obtain an additional 20 acres at the site, the Moran facility could fulfill these minimal growth demands until about 1990.

Such a strategy of ignoring domestic feeder growth would appear to be shortsighted and self-limiting. Even though Sea-Land has currently given no indication of a desire to expand its domestic feeder operation in the Port of Boston over the next two decades, the potential for expansion of such services looks promising, using even the most conservative estimates. As larger container ships become more common on the deep-sea legs of major trade routes, the Port of Boston's emphasis is likely to shift even more to a feeder operation.

The larger container vessels will be less likely to make intermediate stops on a trans-ocean leg for economic reasons, and Boston is well situated, in terms of distance from New York, to serve as a waterborne feeder facility. The economics of intermodal transfer and waterborne versus land-haul feeder operations are such that a coastal feeder facility must be highly efficient in terms of transfer and load factors. This condition implies that domestic feeder facilities are best handled as private facilities (e.g., Sea-Land) rather than as public terminals. Given sufficient demand Sea-Land should be interested in expansion but, if not, is should be relatively easy to attract other shippers of a similar type to the Port.

On this basis, the conclusion is that the Massachusetts Port Authority should undertake an expansion program which would provide the equivalent of two additional container berths plus the supporting elements (cranes, storage areas, marshalling facilities, land access, etc.) to be operational by 1978. Once these facilities are operational, one berth would be used as a public container terminal and the other either as a public or a private terminal, depending upon traffic mix and requirements.

2 FINDING A LOCATION

Mystic Terminal

REQUIREMENTS FOR CONTAINER FACILITIES

Land

Container terminals are generally characterized by large areas of flat open land. At least 25 acres should be designated for the initial berth at a terminal and 20 acres for each additional shipping berth: 18 acres of the initital berth are for container storage, about two acres for a freight consolidation shed and maintenance facilities, one-half acre for an Administration Building which would serve the entire terminal, and the remainder for access roads, railines, etc.

Marginal Berthing

The size of container ships has grown over recent years until they are now from 850 feet to 900 feet long. A marginal berth of at least 1,100 feet is required to tie up a vessel of this size. When not used by a large ship, several smaller ships which still comprise most of the fleet could be accommodated within this distance. Marginal berths are usually used to facilitate linear movement of large container cranes. Cranes have gage widths between 50 and 100 feet, making turns difficult.

Terminal Facilities

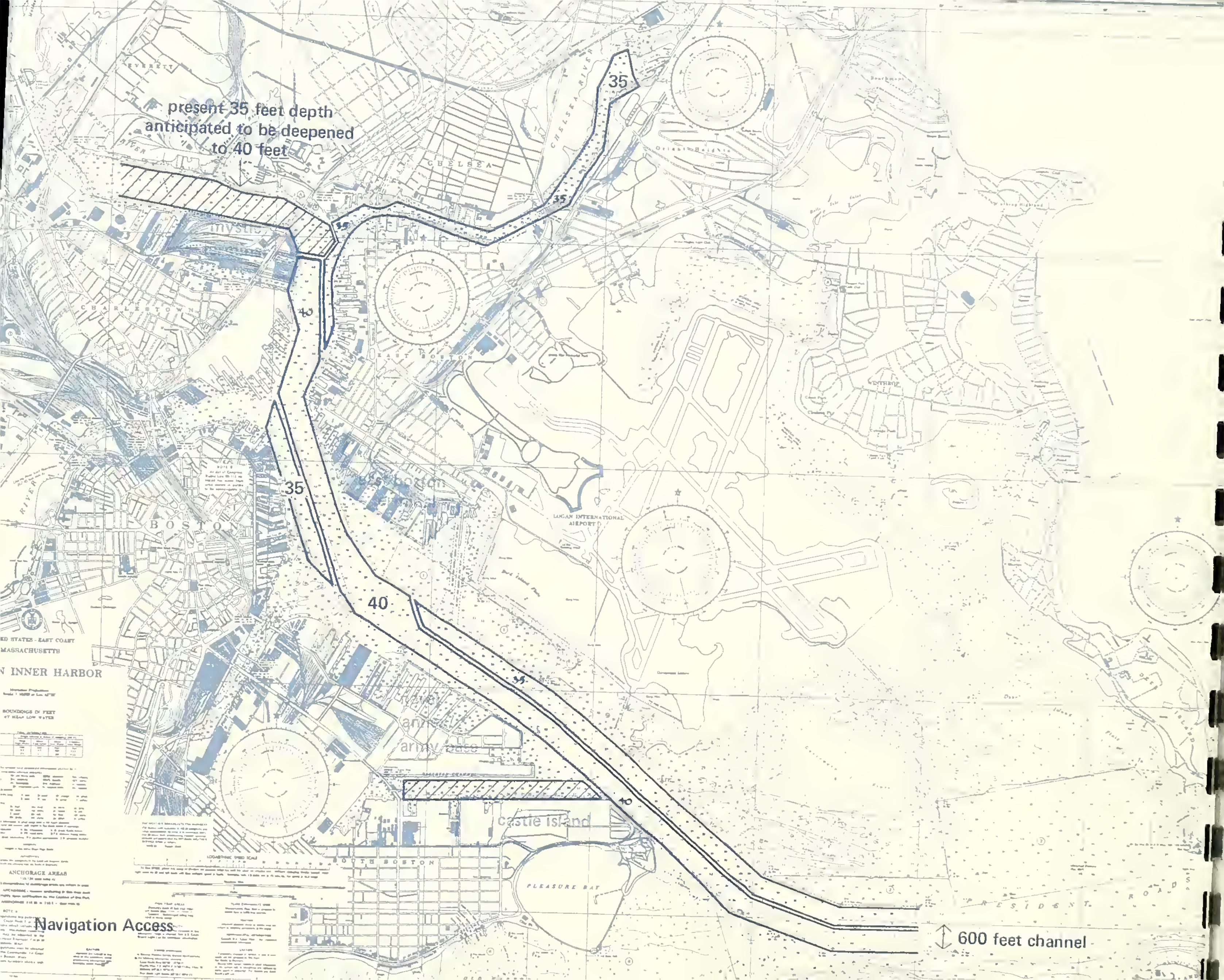
Modern high-speed container cranes may be as high as 240 feet above the wharf with the boom raised, and have a lifting capacity of up to 70 tons. The gage width can vary from 50 to 100 feet. If required, curved tracks are laid on a minimum radius of 300 feet. Low profile cranes from 100 to 110 feet high, with capacities of up to 40 tons, while more expensive, are available for areas where there are height restrictions. The wharf structure must be specially reinforced to take the large wheel loads imposed by container cranes.

The terminal must have sufficient traveling gantry cranes, straddle trucks and container chassis to move the containers to and from the ships and to arrange and stack them in the yard. The paved yard area for container storage should be flat but well drained, with a minimum bearing capacity of 1,000 p.s.f. It must be suitably marked to delineate container storage spaces and access roadways. The yard must be laid out to be easily accessible to yard equipment and to rail and truck transportation routes. The yard should be lighted for night time operations and security.

Large warehouses are eliminated in the container concept. The amount of cargo that must be packed and unpacked (or "stuffed and stripped") at the terminal must be minimized, or the benefits of containerization are lost. A freight consolidation area of about 80,000 square feet per berth, including parking and loading areas, is usually sufficient. This building should preferably be long and narrow, to provide a maximum number of truck docks.

Adequate utilities must be provided to serve the limited needs of a container terminal. Sufficient potable water and electricity must be provided to each berthing station, and telephone connections may also be necessary.

With minor changes, conventional container terminals can also serve roll-on, roll-off vessels. For those ships which load and unload from the side, suitable ramps to the wharves must be provided. A conventional finger pier arrangement may be used for those ships which load and unload at the bow or the stern. Additional storage space is required for cargo transported by roll-on, roll-off vessels since the containers are mounted on trailers which cannot be stacked.



Navigation Access

NAVIGATION

A container facility should be located as close to the open sea as possible to reduce the nonproductive time spent in traveling through the harbor at slow speeds. The channel should be wide and straight and of sufficient depth at low water to accommodate the new container ships. The drafts of these ships, fully loaded, range from 30 to 35 feet. Although these ships have been increasing in capacity, the need for new container ships to serve old established harbors (which have channels from 35 to 40 feet deep) will limit the draft requirement for these new vessels.

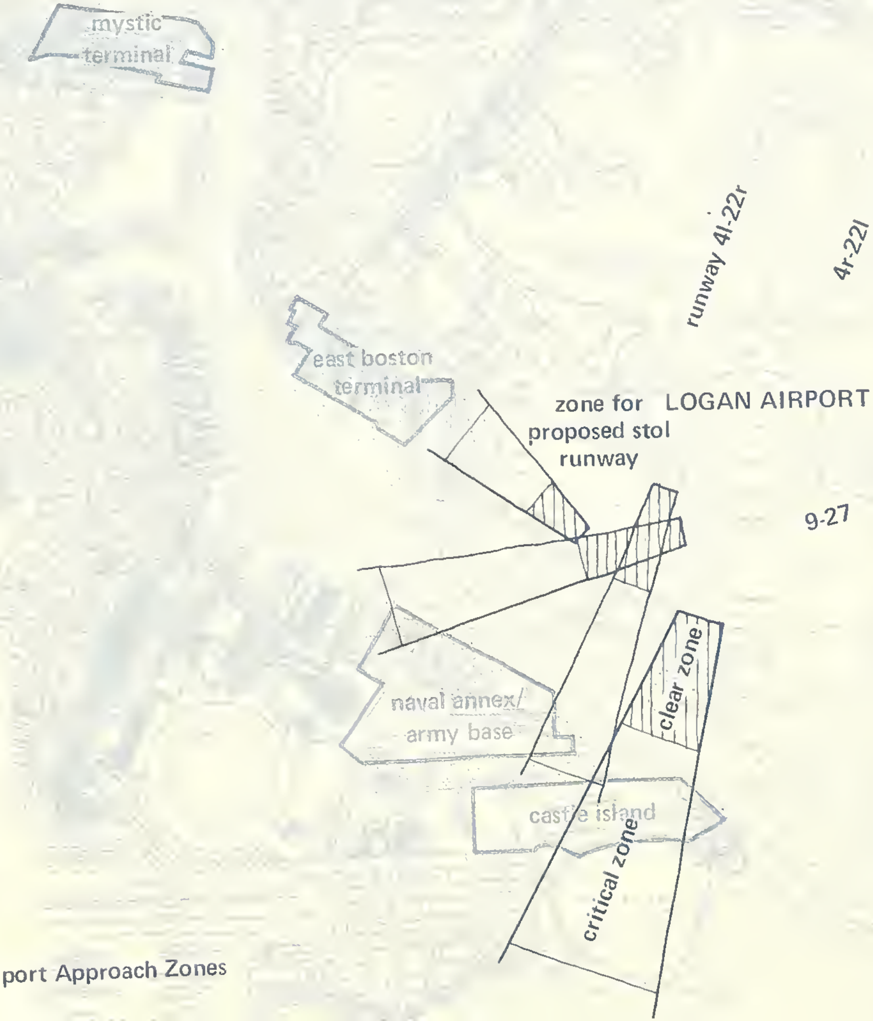
It would usually be desirable to have a turning basin close to a port facility so that a ship could turn without the aid of tugs. Although the preferred size for the larger container ships is about 3,600 feet, half of this length is generally be considered acceptable. A basin smaller than 1,800 feet requires maneuvering with the aid of tugs.

The present channel maintained in the Inner Harbor has a width of 1,200 feet from President Roads to the Charles River and decreases to less than 600 feet wide at the Mystic River Bridge. The channel depths at low water are 40 feet for the outbound portion of the main channel and 35 feet for the inbound side. Future planning by the Corps of Engineers calls for maintaining a 40 foot minimum channel depth, but only 600 feet wide from President Roads to the Mystic River Bridge.

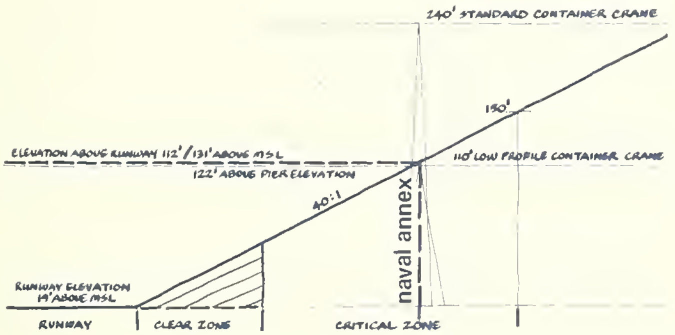
Weather conditions are important to port operations for two major reasons: fog may delay ship arrivals and departures, and high winds or strong currents may make docking hazardous. Further, it is difficult to operate large container cranes in winds exceeding 30 mph. The prevailing west to east air flow in Boston has periodic alternating intrusions of tropical and polar air, which in turn can result in rapid weather changes. Prevailing winds across the harbor are usually from the northwest in winter and from the southwest in summer. The hurricane season with its strong southwest winds generally extends from early September through October. Because of the substantial tidal range (9.5 feet) within the harbor, there would not be any significant icing conditions.

Precipitation remains fairly constant throughout the year, with an average monthly rainfall between 3 and 4 inches. In an average year there are 100 clear days, 106 days of partly cloudy weather, and 159 days of cloudy weather. Fog occurs on an average of 2 days per month. Temperatures normally average from a mean low of about 25 degrees F. in January and February to a mean high of about 78 degrees F. in July.

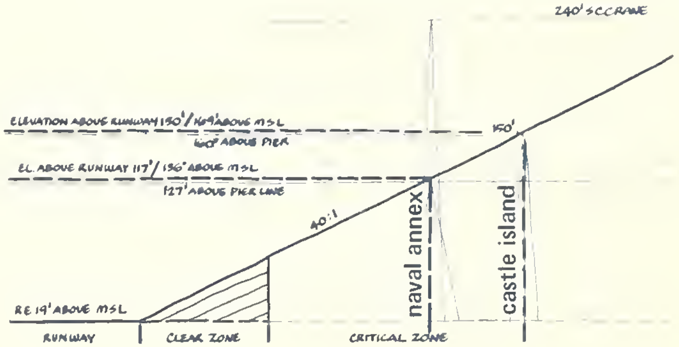
The orientation of approach zones for aircraft landing at Logan Airport may restrict the height of cranes that could be utilized at a new site. These zones control the passage of aircraft in their final approach over shipping in the main channel. The approach zones commence 200 feet beyond the end of each runway and extend upwards on a slope approximating 50 to 1.



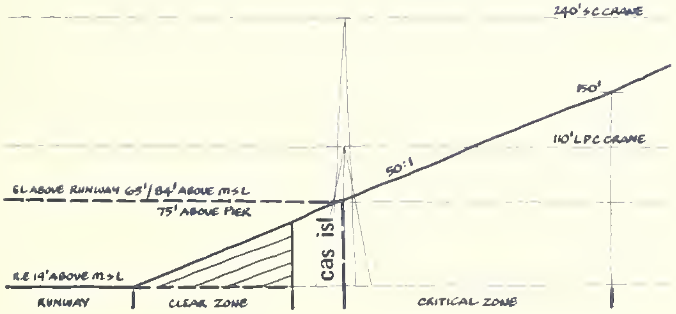
Logan Airport Approach Zones


240' STANDARD CONTAINER CRANE
150'
ELEVATION ABOVE RUNWAY 112'/131' ABOVE MSL
122' ABOVE PIER ELEVATION
110' LOW PROFILE CONTAINER CRANE
40:1
naval annex
RUNWAY ELEVATION
14' ABOVE MSL
RUNWAY
CLEAR ZONE
CRITICAL ZONE

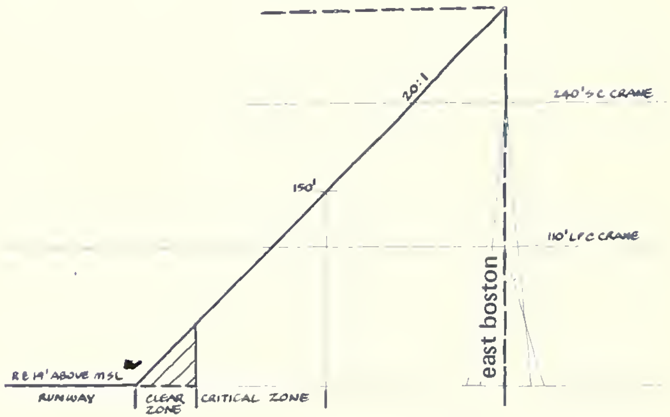
runway 9-27



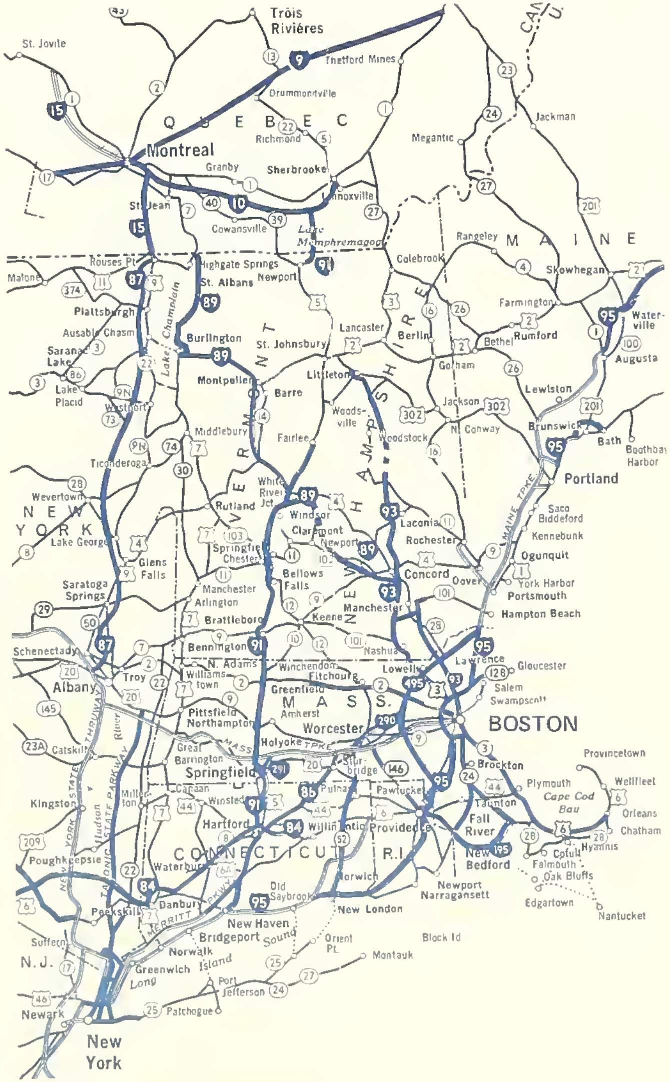
runway 4l-22r



runway 4r-22l



proposed stol runway



Regional Highway Networks

LAND TRANSPORTATION ACCESS

Introduction

The two major modes of land transportation for container movement are rail and trucking. Future continued growth of the Port demands that both modes be considered in evaluating sites. A rapid, high-frequency and reliable rail network can have significant effects on container traffic patterns. Many transatlantic exporters to the American Midwest are now using Canadian ports in preference to those of the Northern United States because container trains, complimented by efficient forwarding, storage and delivery services have provided an overall greater benefit. To attract future container shipments away from New York and Baltimore as those ports become more crowded, rail will provide for the most economical movements beyond 500 miles. Conversely, if only trucking is considered for future movements, New England will be the only prime area from which substantial business could be attracted into Boston. In addition, shipments of domestic goods from outside New England would also improve the present imbalance of exports over imports. Since Boston's short-term market is mostly within a 500 mile radius and its long-term potential market is beyond this limit, both modes are expected to play an equally important role in the Port's growth.

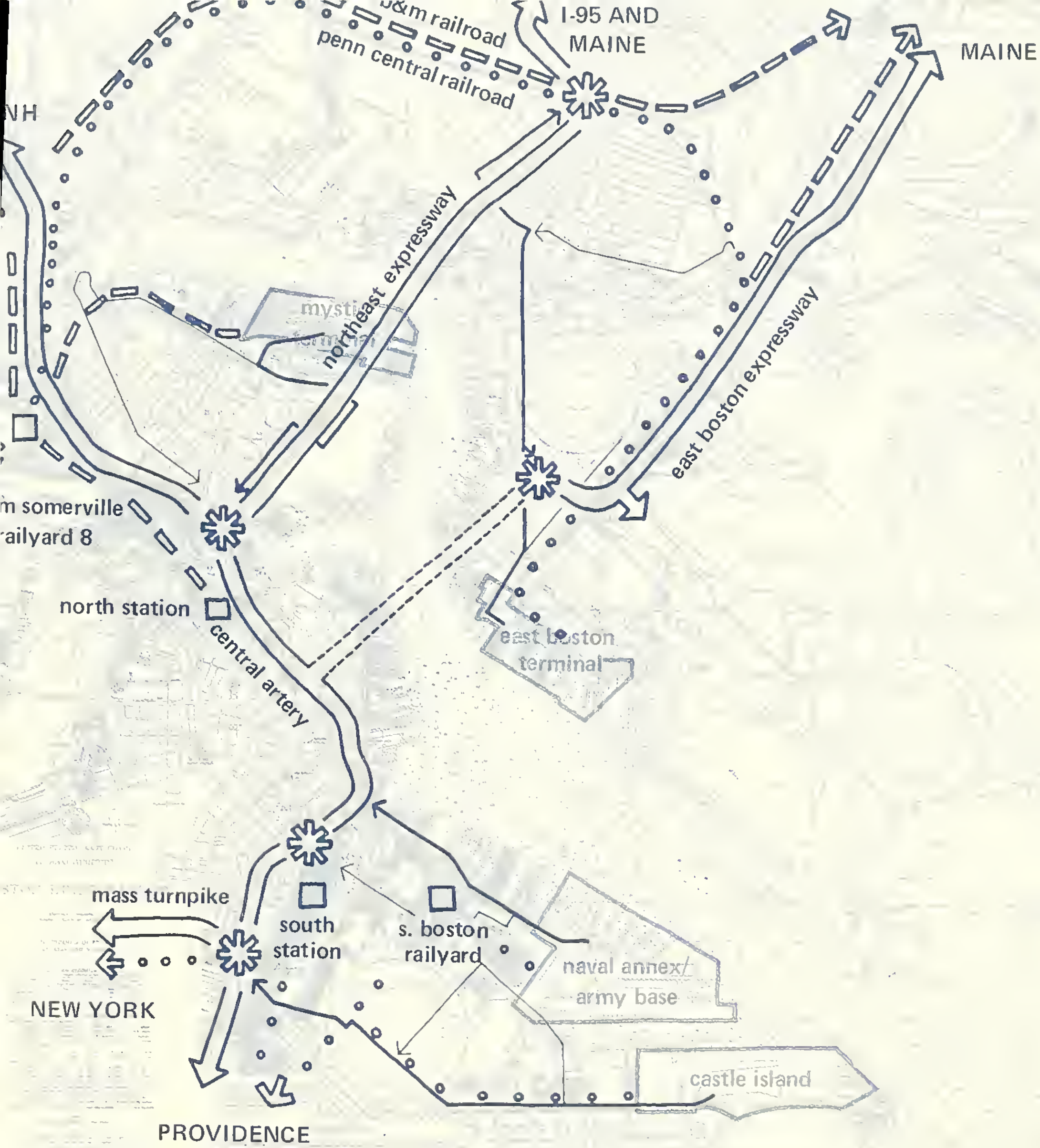
Regional Highway Networks

The Greater Boston area is served by a regional system of Interstate highways and limited access arterial roads, all of which terminate in or pass close to Boston. The radial highways extending from Boston include I-93, I-90 (Massachusetts Turnpike), I-95 and Route C-1. The area is also served by two circumferential highways, Route 128 and I-495, both of which connect with the major radial routes from Boston.

The Massachusetts Turnpike (I-90) extends to the New York Thruway and has connections to the major North-South routes crossing Massachusetts (I-91, I-86, Route 7, and Interstate spurs such as I-290 serving the Worcester area). New Hampshire and upstate Vermont are served by I-93. At Concord, New Hampshire, I-93 interconnects with I-89, providing easy access to mid-state and Northwestern Vermont. Route I-95 (North) serves southeastern New Hampshire and Maine and terminates at the Canadian border. Highway routes extending to the South and Southwest include I-95 and I-86/84 in conjunction with the Massachusetts Turnpike.

Access to the regional highway network from harbor facilities is compounded by the proximity of the downtown area, which at times limits rapid access from the immediate harbor area. The major problem areas in the local system are the Central Artery and the harbor crossings (the Sumner and Callahan Tunnels and the Mystic River Bridge).

Wherever a new facility is to be located, some traffic will have to utilize one or more of the existing transportation facilities. The volume and routing of traffic movements will



Local Access Routes

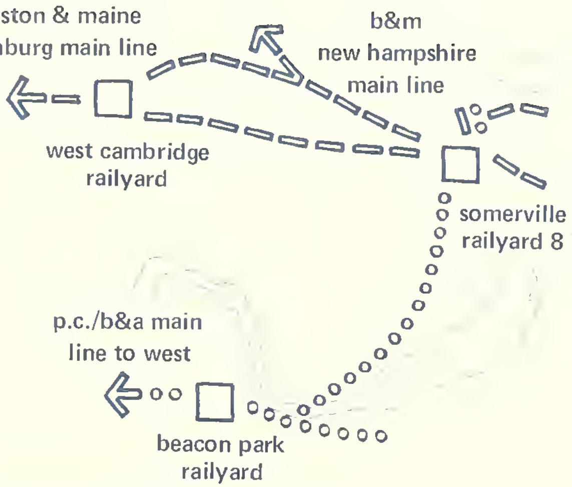
depend on each particular site. New facilities recommended by recent transportation studies, such as a new third harbor tunnel and improved mass transit, should alleviate some of the congestion problems now caused by inefficient automobile movements by downtown commuters. If adequate improvements to the local highway system are accomplished, direct access from dockside to and beyond the New England region would be excellent.

Regional Rail Networks

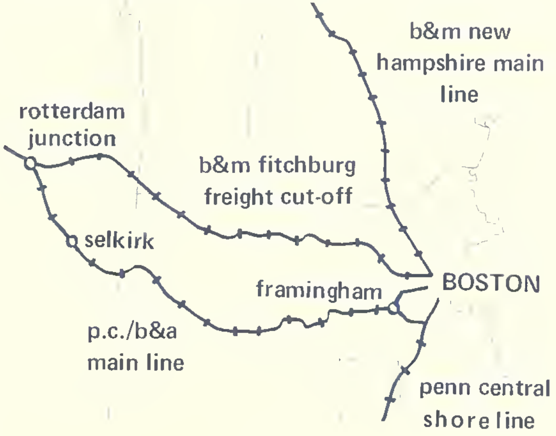
Boston is served by two railroads, each having two freight routes. The Penn Central Railroad operates both the Shore Line branch through Providence and the Boston & Albany freight route to Washington and Chicago, with connections in Chicago to the West Coast. The Boston & Maine Railroad operates the Fitchburg cut-off to the West and the New Hampshire Main Line to Maine, Vermont, and New Hampshire, with additional connections to Canada.

At present, the Penn Central operates more than 35 through and local freight trains through its major classification yards in Framingham, Beacon Park (Allston), and South Boston. The primary Penn Central terminals for "piggyback" traffic, with containers mounted on chassis, are at Beacon Park and South Boston. All container traffic is on- or off-loaded at these facilities and is carried by tractor to its dockside destination.

The Penn Central Railroad has been in serious financial difficulty for several years, and has recently implemented policies which are aimed at overall cost reductions. These policies include moving yard work from Boston to yards in Providence and Framingham; encouraging all through-freight movement to pass over the Boston & Albany main line through Selkirk, New York, (Penn Central's major electronic rail-switching yard); and encouraging the shipment of containers through the Port of New York. The ultimate result of these policies are detrimental to the rapid movement of containers through Boston, since containers are now being loaded onto trucks several miles from dockside, with substantial time delays.



Rail Access: Boston Railyards System



Rail Access: National and Regional System

The Boston & Maine Railroad has major classification yards in West Cambridge and in Somerville, from which more than 20 through and local freights operate. Charlestown and Chelsea can both be conveniently served from these yards, but since there are no direct lines now utilized to dockside, container movement by rail is slow and inefficient.

The Boston & Main Railroad is also developing operational policies to improve their economic conditions. Although there could be direct rail access to the Moran Terminal from a rail yard only 1-1/2 miles away, the fee charged for that transit is such that it is more economical to unload a container onto a tractor at the rail yard for delivery to the docks.

The rapid movement of containers to and from Boston is severly impeded when switching is required between the two railroad systems. Switching involves both a time delay and additional costs, both of which are contrary to the ultimate goal of moving container traffic in the shortest time and at the least cost. There is a connection between the two systems, but the routing crosses several major roadways in Cambridge at-grade which greatly increases time required to make the connection. The next connection is located at Rotterdam Junction, New York, some 200 miles west of Boston.

Efficient transfer of containers through the Port of Boston to points within its market area by rail will be hampered if a noncooperative attitude exists between the railroads. However, if both railroads were to acquire a bigger share of future container transportation, this may be an area of possible improvement. Adequate trackage is generally available, and any necessary capital investment would be limited to improving the flexibility of the total system by a more direct connection to the Penn Central main line to the West. Policy improvements should also include direct loading of containers on the docks, and the possible joint use of rights-of-way by both railroads, especially for local connections. If the railroads could be convinced that better service to Boston's harbor facilities would be economically viable, both Massport and the railroads would benefit from more efficient rail operations.

ENVIRONMENTAL FACTORS

Introduction

Boston Harbor is a tidal estuary which receives fresh water from the watersheds of the Charles, the Chelsea, and the Mystic River basins. The harbor, as a physiographic and ecological feature, has been greatly modified over the last 200 years by filling operations which removed much of the intertidal and subtidal areas from its natural marine environment. Although substantially altered by these activities over the years, the natural productivity of the harbor remains viable, especially where pollutants are diluted by ocean waters and marine organisms can tolerate the existing levels of pollution. These areas are generally most evident in and about the outer harbor area.

The major environmental considerations which define the present state of the Boston Inner Harbor involve both the water quality and the various human factors concentrated in the surrounding urban centers. The water quality throughout the Inner Harbor is presently classified as poor by the Massachusetts Water Resources Commission. Their recent pollution survey of Boston Harbor (April, 1973) clearly defines the widespread and marked pollution present throughout the harbor as recorded at 167 sampling stations. Past and current ecological surveys similarly indicate the overall reduction in natural productivity and ecological diversity of the harbor for the past few decades.

The environmental assessment of each of the alternate sites under consideration includes evaluation for water quality, air quality, and the noise climate at and adjacent to each site. These individual criteria involve both short-term and long-term aspects, which often overlap and are complex by their very nature.

Water Quality

Each of the sites studied will require varying amounts of site preparation and related earthwork operations for an efficient terminal. Dredging will be required to prepare deepwater conditions adjacent to the wharves. The short-term danger of uncontrolled sedimentation, due to migration of dredged materials, can be minimized through both design criteria and close control of construction techniques.

In the past, sewage and natural eroded materials from storm run-off have been carried into harbor waters, where much of the sediment load has then settled out. It is usual to find a high content of heavy metals, such as mercury, zinc and cadmium, in the upper few centimeters of harbor-bottom sediments. As the total depth of sediments being dredged is intermixed, these toxic substances are often diluted to a level below the EPA standards for disposal. Regardless of actual composition, every effort should be made to avoid redistributing these fines throughout the harbor during dredging.

There is not expected to be any adverse long-term impact upon water quality in the harbor, since the concept of containerized operations is clean. Spillage of materials is not expected since all transfers are by sealed container. On-site drainage systems will prevent the runoff of any contaminated surface water into the harbor by using sedimentation and oil traps. Domestic sewage generated from the site and from docked vessels will be conducted to the land-based collection and disposal system. All necessary future maintenance dredging would be conducted as regulated and approved by the appropriate regulatory agencies.

Air Quality

During construction, air quality would be protected through the use of dust control practices, including the use of covered vehicles for the transport of fill and other dust-producing materials. Water and/or other wetting agents would also be used for dust control during construction, and these areas would be covered or stabilized as soon after construction as possible.

The long-term impact upon air quality would be primarily determined by the land traffic movements. Traffic design criteria must emphasize the efficient flow of vehicles, in order to minimize air pollution which increases as engine strain increases. The requirement that all vehicles meet EPA clean-air operational standards will further minimize vehicular pollutants.

Noise Climate

Noise generation during construction at the site would be minimized by proper maintenance of construction vehicles and by limiting construction activities to daytime hours. Placement of compressors, pile drivers, and other noise-generating equipment away from residential areas will also reduce noise impact. If this is not possible, noise reflecting shields or mufflers could be used.

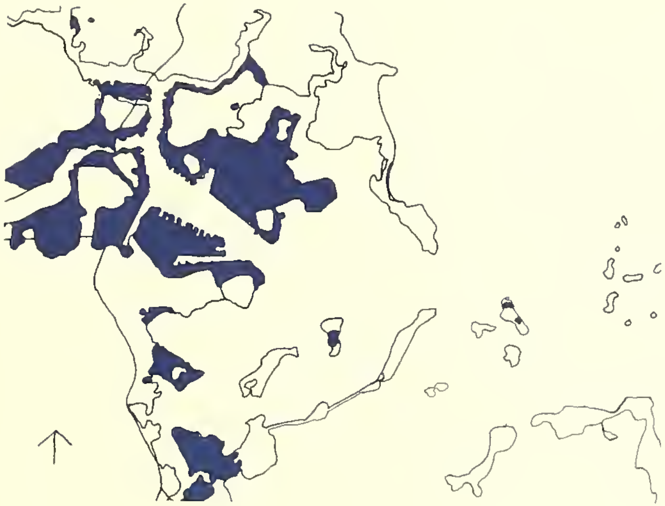
Long-term noise impacts would be primarily associated with truck movement to and from the site. Noise from operation of the facility will not be significantly greater than the background noise now present from daily waterfront operations.

Environmental Parameters

In order to fully evaluate the environmental effects of a specific site, it may be necessary to prepare an Environmental Impact Statement. This determination would be made at a future date by EPA, whose approval is required prior to final action by the Corps of Engineers on permit applications for dredging or over-water construction. Recommendations in this report must be contingent upon results of an approved Environmental Impact Statement, should it be required at a future date. It will be especially important to consider the following main points:

The *present* ecological conditions of the selected site. An ecological survey should be undertaken to associate past environmental data in the harbor with present conditions. This would also include an analysis of sediment composition and a determination of the ultimate level of toxic substances dissolved in harbor water after disturbing those sediments.

The *predicted* impact of development of the selected site upon the existing natural and human environments around the site, based on the available information and the proposed ecological survey.



Filled Areas In Boston Since 1775

GEOLOGY OF THE BOSTON AREA

The Greater Boston area lies within a geological depression known as the Boston Basin. The rock formations comprising the bedrock floor of this depression are called the Boston Bay Group, which includes the following separate formations:

Cambridge Siltstone
Squantum Formation
Roxbury Conglomerate

The Squantum Formation and the Roxbury Conglomerate are generally found in the westerly part of the Basin and around its perimeter towards the south. Cambridge Siltstone, a dark-gray argillaceous rock varying from medium soft to moderately hard, is found in the remainder of the Basin and is particuarly predominant in the downtown Boston area.

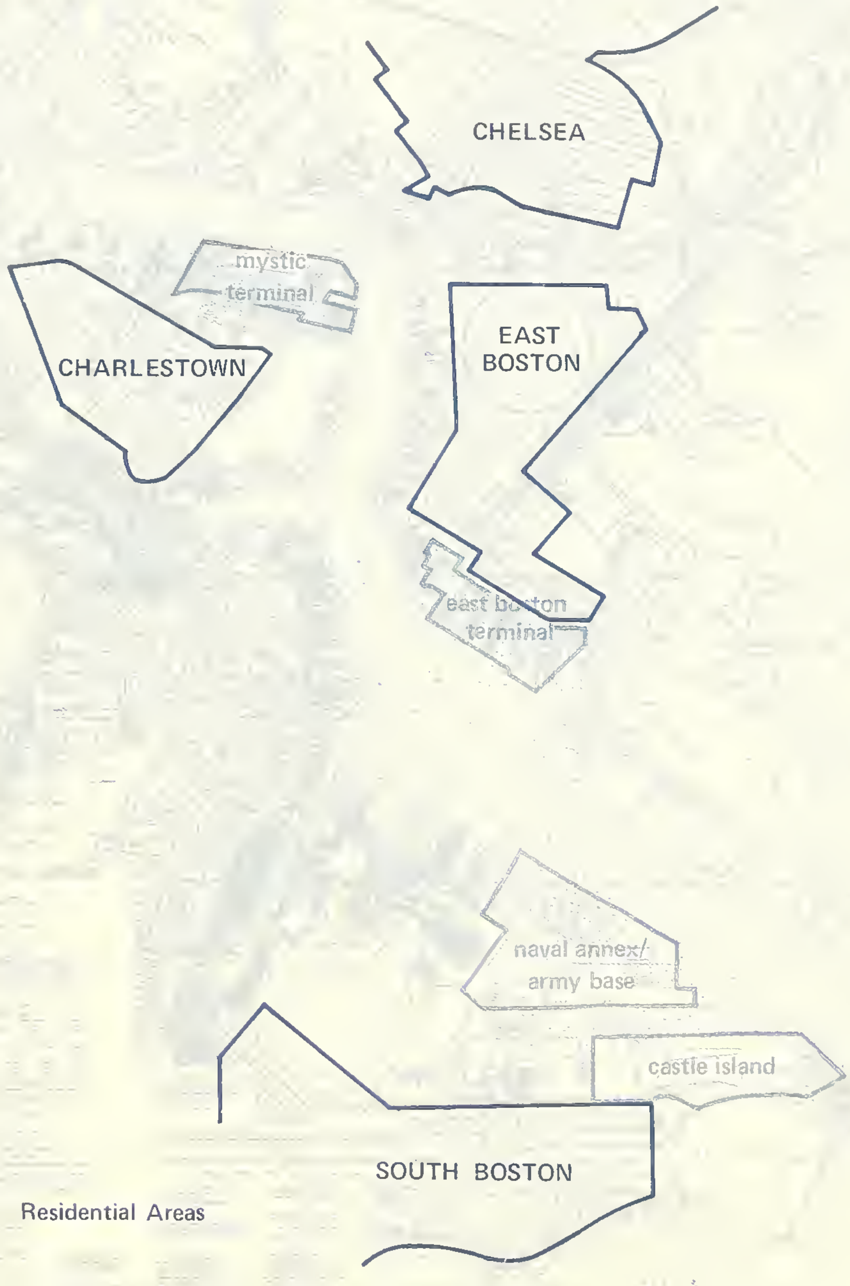
These bedrock formations were worked upon and eroded by four separate periods of continental glaciation during the Pleistocene era. The last glacial period, the Wisconsin, was the most extensive of these glaciers. Older deposits which had remained to that time were obscured and obliterated during this period as the glacier advanced and then receded. Glacial deposits resulting from this most recent glaciation include till, sands and gravel, and clays.

The till (or hardpan) is commonly found as both a thin sheet-like moraine deposit and as oval-shaped hills called drumlins. Many of the harbor islands are drumlins, and it is likely that glacial till comprises a considerable portion of the harbor floor. Stratified sand and gravel deposits (or outwash) have since resulted from the subsequent erosion and redeposition of glacial moraine from upstream areas.

Substantial clay deposits of glacial origin are found throughout much of the Boston Basin. These clays are the result of deposition in quiet waters of exceptionally fine materials eroded from the upstream glacial deposits. The surface of the clay deposit is often weathered due to oxidation and desiccation, and the remainder is of moderately soft consistency. The properties of this clay deposit are especially important when considering possible engineering alternates.

The soils of glacial origin have since been overlain by sands and gravels, and later by freshwater and saltwater peats. These peats are fibrous in nature and are in turn overlain by a thin cover of very soft black organic silts (or "muds") of recent origin.

Starting in the early to mid-1800's, Boston has developed from its natural condition by extensive filling over the shoreline muds. Gravel fill was deposited directly upon the organic silts and surface peats. The present-day shoreline around the harbor was formed as a consequence of this filling, which represents a substantial proportion of the downtown area of the city. It also includes almost all of Logan Airport, the entire South Boston waterfront, and extensive portions of East Boston and Charlestown.


Residential Areas

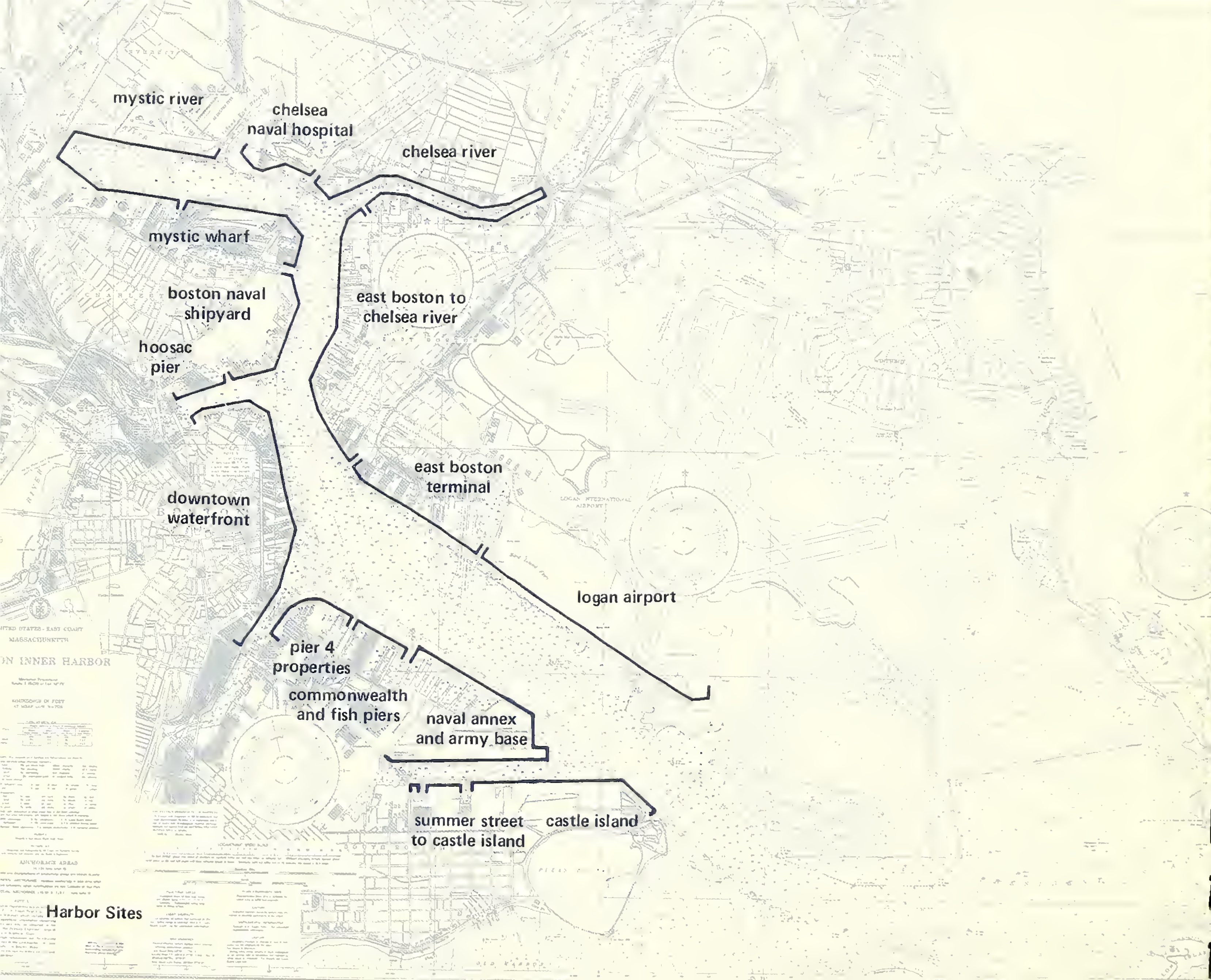
THE COMMUNITY

The impact of the container terminal upon the surrounding communities - existing land uses, future planning programs, housing conditions, and social and economic profiles - has been evaluated for each of the sites studied. These sites include the Naval Hospital in Chelsea; the Mystic Wharf and Naval Shipyard in Charlestown; Massport Piers in East Boston; and Naval Annex and Castle Island in South Boston.

There has been an outward migration from all communities during the last ten years - the greatest loss occurred in Charlestown and the least in Chelsea. For comparison, Boston had a lower out-migration than any of these communities. The percentage of nonwhite population in each of the communities is much lower than Boston. South Boston has the largest percentage of elderly population and Charlestown the lowest. Charlestown, however, has the highest percentage of younger population and East Boston has the lowest. In terms of the total dependent population, there is no significant difference in all communities.

The number of housing units has decreased in all communities during the last 10 years. The percentage of reduction in Charlestown, 20.5%, is the most serious, amounting to about 10 times the reduction rate in the other communities. During this time, Boston had a reduction of only about 2.7%. Charlestown has the highest percentage of units with more than one person per room. This could be due to its substantial housing loss. Vacancy rates in the communities are about the same, about 6%, as the City. The owner-occupancy rate is highest in Charlestown and lowest in South Boston. Chelsea has both the highest median value and highest median rent, while South Boston has the lowest median value and East Boston the lowest median rent. East Boston has the most units without adequate plumbing facilities and Chelsea the least. The lower median rent in East Boston and the higher median value and rental in Chelsea are reflections of these conditions.

The socio-economic profile of a community describes the median family income, employment and occupational characteristics of the residents and their level of education. Chelsea has the highest income and East Boston the lowest, but the median family income in all communities is lower than Boston. Chelsea has the highest percentage of professional and managerial jobs, the lowest percentage of semi-skilled jobs, and the lowest overall unemployment. These factors obviously contribute to Chelsea having the highest median family income. East Boston is lowest in professional and managerial jobs, as well as median family income. Charlestown and South Boston have about equal percentages of clerical and sales jobs, and rank higher than the other two communities. They also rank second and third, respectively, in median family income. Unemployment is about the same in East Boston, Charlestown, and South Boston. Chelsea ranks highest in college education and East Boston the lowest. The percentage of college educated residents in all communities is less than half that for Boston. East Boston also has the lowest percentage of residents who have completed high school. These statistics reflect the income and occupational characteristics discussed previously, i.e., Chelsea is highest in median family income and numbers of professional and managerial jobs and East Boston the lowest in both of these factors.



Harbor Sites

HARBOR SITES

Introduction

The initial step in the site evaluation process includes a survey of the existing physical facilities around the entire Inner Harbor, proceeding counterclock-wise from Logan Airport to Castle Island. Survey was not made of sites beyond the Inner Harbor area. Sites were grouped into common areas as appropriate due either to ownership of parcels, community development plans, or common constraints.

Each of the sites is initially discussed in the following brief sections. Some have obvious overriding constraints and were dropped from further evaluation.

Logan Airport

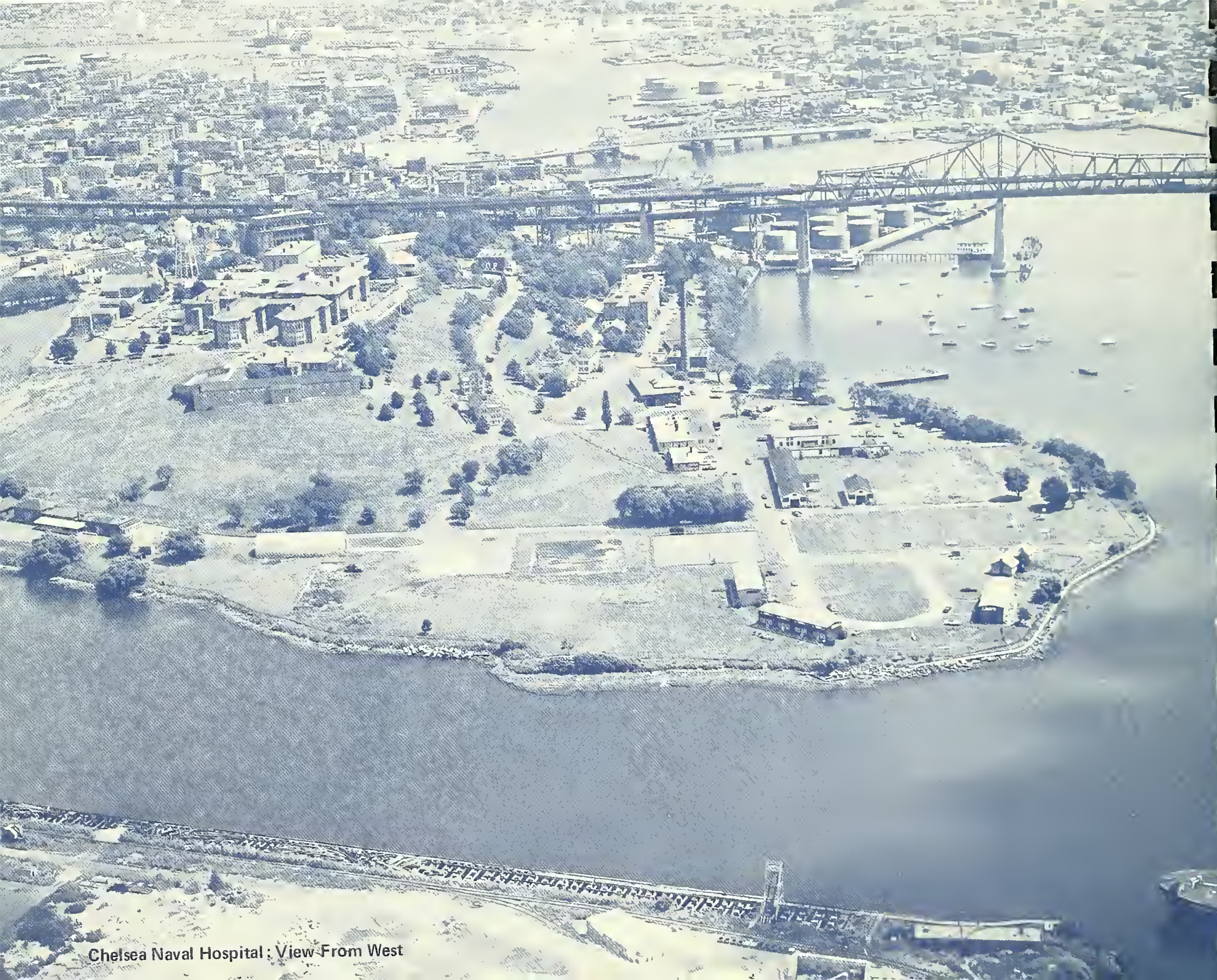
Seaport development within the limits of Logan Airport is neither desirable nor legally feasible. F.A.A. regulations establish approach zones at the ends of operating runways which rule out any intrusion into these air spaces, inevitable with both container cranes and superstructures of docked ships. The airport must be ruled out from futher consideration for seaport development.

East Boston Terminal

This potential site extends from the westerly end of Logan Airport and includes the Bethlehem Steel Company shipyard and the existing Massport Piers 1, 3, 4 and 5 at the East Boston Terminal.

Future development would be limited to only that area presently owned by Massport. Local constraints include the existing street system around Maverick Square and the Sumner-Callahan Tunnels, and the clear zones required for a proposed STOL runway at Logan Airport.

Because both the Charlestown Navy Yard and the South Boston Naval Annex complex are scheduled for imminent closing, the shipbuilding operations of Bethlehem Steel might possibly be relocated into either of these facilities. Development of this resulting land area by Massport would make both airport and seaport operations more contiguous. For these reasons, a more detailed investigation of the site will be made in the next section of this report.


Chelsea Naval Hospital: View From West

East Boston to Chelsea River

This site runs along the west side of East Boston from the Massport Pier 1 to the Chelsea River. A terminal along this area would involve the acquisition of considerable private property and would conflict with existing and proposed housing and other community related features. The major shopping center in East Boston is located along the waterfront at Central Square, dividing this total area in half. Future practical development of a port facility would be limited to that area southwest of the shopping center. Navigation to the site is difficult, since it is near a turning point in the main shipping channel. Because of the expected difficulty of land acquisition, probable navigation delays in docking, conflicts with proposed community development and the difficult land transportation routes through East Boston, this site does not warrant further evaluation.

Chelsea River

Sites along both sides of the Chelsea River do not satisfy the navigational requirements for the larger ships. The channel is narrow and twisting, with two major drawbridge crossings. Since an important factor in efficient container operation is an unimpeded navigational approach, sites along the Chelsea River are not desirable and should not be considered.

Chelsea Naval Hospital

This site is opposite the existing container facilities at the Moran Terminal in Charlestown. It is presently scheduled for disposition by the federal government as part of the current (1973) military cutback. The present land area of the hospital comprises 88 acres and is situated upon a large glacial drumlin rising to above elevation 110.

Site preparation would require moving more than 5,000,000 cubic yards of materials. Substantial filling into the river would not be allowed since it would interfere with the shipping channels. Further expansion would be limited to the westerly direction, parallel to the Mystic River. If the shoreline were straightened by filling upstream of the Tobin Bridge to the edge of the main channel, approximately 1970 feet of marginal berthing would be made available. This would accommodate two berths — a large ship and an average-sized ship.

This site is approximately 4 miles from the mouth of the Inner Harbor, and there are several sharp turns in the main ship channel before reaching this area. Because of the width constriction at the Tobin Bridge, large ships often turn around at the Chelsea River and then back upstream under the bridge aided by tugs.

There are several large buildings of brick and stone construction on the site which would be expensive to demolish. The area is now being studied by the city for a variety of potential uses, all related to housing and community activities. These factors, coupled with the extensive earthwork operations which would be required to prepare the site for a container terminal, eliminate the site from further consideration.

Boston Naval Shipyard

Mystic River Area

Upstream sites along the Mystic River are not practical for development of a new container terminal. There are several existing industries on both sides of the river which depend upon marine shipping. Displacement of these activities would be both difficult and undesirable; therefore, sites along this portion of the Mystic River should not be analyzed further.

Mystic Wharf Area

The Mystic Wharf area in Charlestown is considered to extend along the Mystic River from the Wiggin Terminals to Mystic Pier No. 1. A portion of Moran Terminal area is leased by Massport to Schiavone & Sons, Inc. and is being used for shipping scrap metal. The U. S. Gypsum Company owns land in the middle portion of this area, preventing the Massport properties from being contiguous with each other.

Although some navigational problems are caused by channel constriction at the bridge, container ships of all sizes utilize the existing terminal. Access to the regional highway network over local streets is relatively difficult. Since Massport owns the majority of this area and a container facility is presently operating at this site, it will be further analyzed as a potential site for additional facilities.

Boston Naval Shipyard

This site is presently used by the U. S. Navy but is scheduled for disposition due to recent military cutbacks. The total area of the site is 130 acres, of which 84 acres is on land. Future expansion of the site would be limited by local features, including the berth of the U.S.S. Constitution at the south end of the shipyard. The "Constitution" will likely remain near its present location after yard closing and probably be dedicated as a national historical monument.

The site is approximately 3 miles from the mouth of the Inner Harbor and lies adjacent to the main shipping channel. There is ample room for dredging of a turning basin near the site to accommodate most of the container ships expected to use the facility.

There are many potential layouts for marginal berthing at this site. By optimizing the longest berthing spaces possible with the least filling, three segments of marginal berthing could be developed. The longest section would be about 2,200 feet, with 2 shorter berths of about 700 feet and 1,000 feet. Aproximately 1,400,000 cubic yards of fill would be required to prepare the site for this layout.

The land portion of the site is almost totally covered with massive buildings of granite and brick construction which would be very expensive to demolish. The entire site has been developed over the years as a shipyard and the shops, utility services and yard equipment are reported to be in reasonably good condition. Of the ten finger piers, half require extensive repairs. There are three dry-docks, all in serviceable condition. The area is ideally suited for continuation as a shipbuilding and ship repair facility.

The disadvantages of conversion of the shipyard to a container terminal far outweigh the advantages to the extent that this site should not be considered further.

Hoosac Pier

Hoosac Pier, owned by Massport, is immediately adjacent to the berth of the U.S.S. Constitution at the Naval Shipyard. Since this site now covers only eight acres and additional acreage cannot be obtained adjacent to the site, it is not suitable for further evaluation.

Downtown Waterfront

The downtown waterfront is an unsuitable site for a container terminal since it would totally conflict with community development plans for the area. The BRA has jurisdiction over the area and development of residential and commercial properties has well progressed over recent years.

Fort Point Channel and Pier 4 Area

The Fort Point Channel area has many navigation constrictions due to its limited depth and width. Maintenance dredging is no longer accomplished in this channel. Moderately active waterfront industry exists at the mouth of the channel near Piers 1 and 2, and Anthony's Pier 4 Restaurant occupies two sizeable portions of this waterfront area. Proposed plans for future private development in this area include a hotel and a shopping complex. Considering the status of these future plans and the limited area available, it is neither feasible nor desirable to develop this area into a container terminal.

Commonwealth and Fish Piers

Commonwealth Pier is utilized as a passenger and cargo terminal, and the Fish Pier is used for unloading, processing and distribution of seafood. It also provides Boston's only dock side freezer (1,000,000 cubic feet). These facilities, both owned by Massport, serve vital functions for diverse shipping interests in the port, and conversion to a container terminal would be undesirable. This site will not be considered in any further detail.

South Boston Naval Annex and Army Base

With the closing of this complex due to the current (1973) military cutbacks, a potential of up to 184 acres of prime waterfront land may become available. The disposition routing of this property through Federal, State and City echelons is not now well-defined.

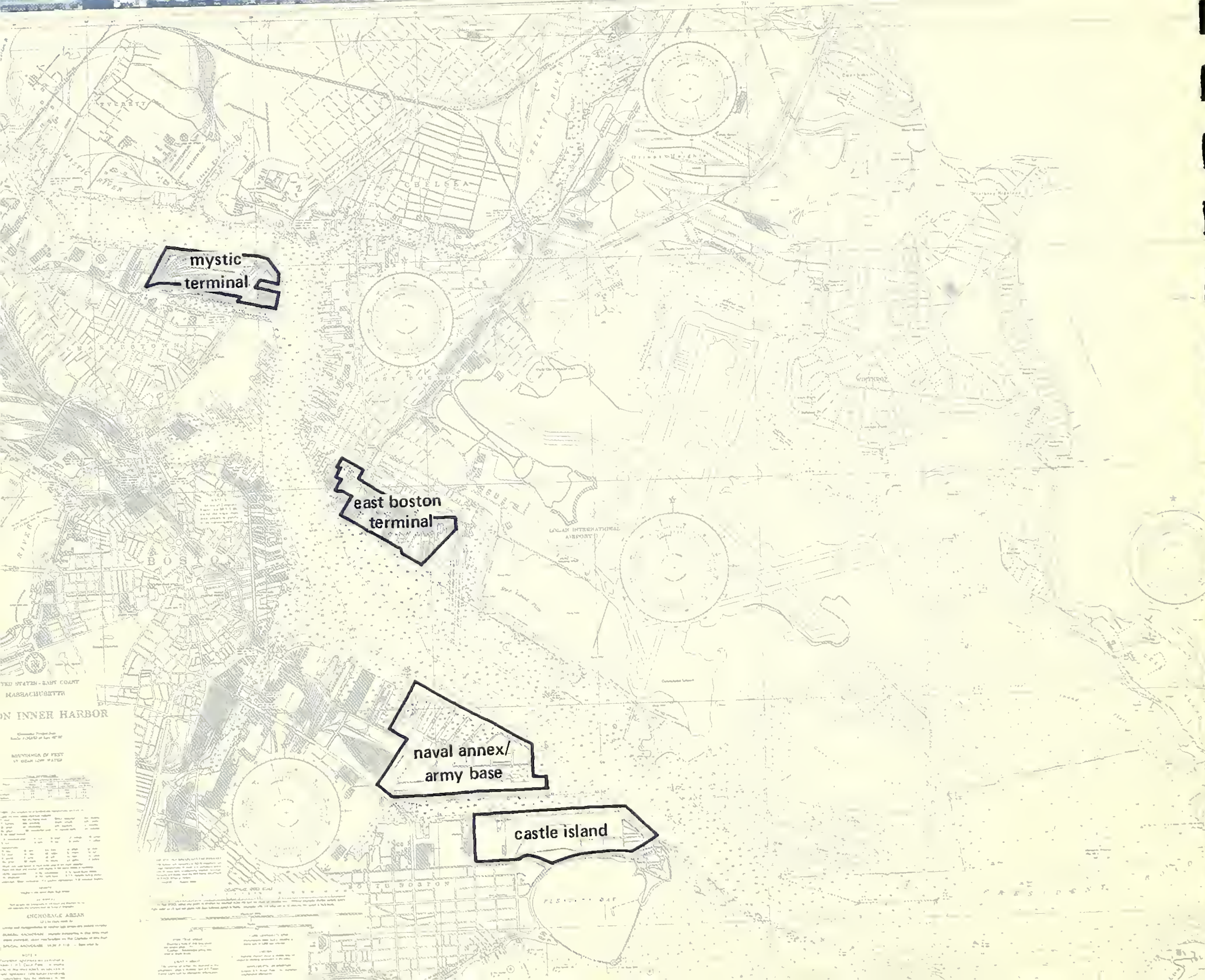
This site does provide the largest land area of any site surveyed within the Inner Harbor. Some of the present masonry structures could be easily demolished. The site has a potential for nearly 9,000 lineal feet of berthing with few navigational restrictions and has access for both trucking and rail transportation. Container cranes of normal height would intrude into the clear zones for Logan Airport, but this could be resolved with low-profile cranes. Although there will probably be substantial time delays and potential legal problems in acquiring the property, this site should be evaluated further because of its many positive factors.

Summer Street to Castle Island

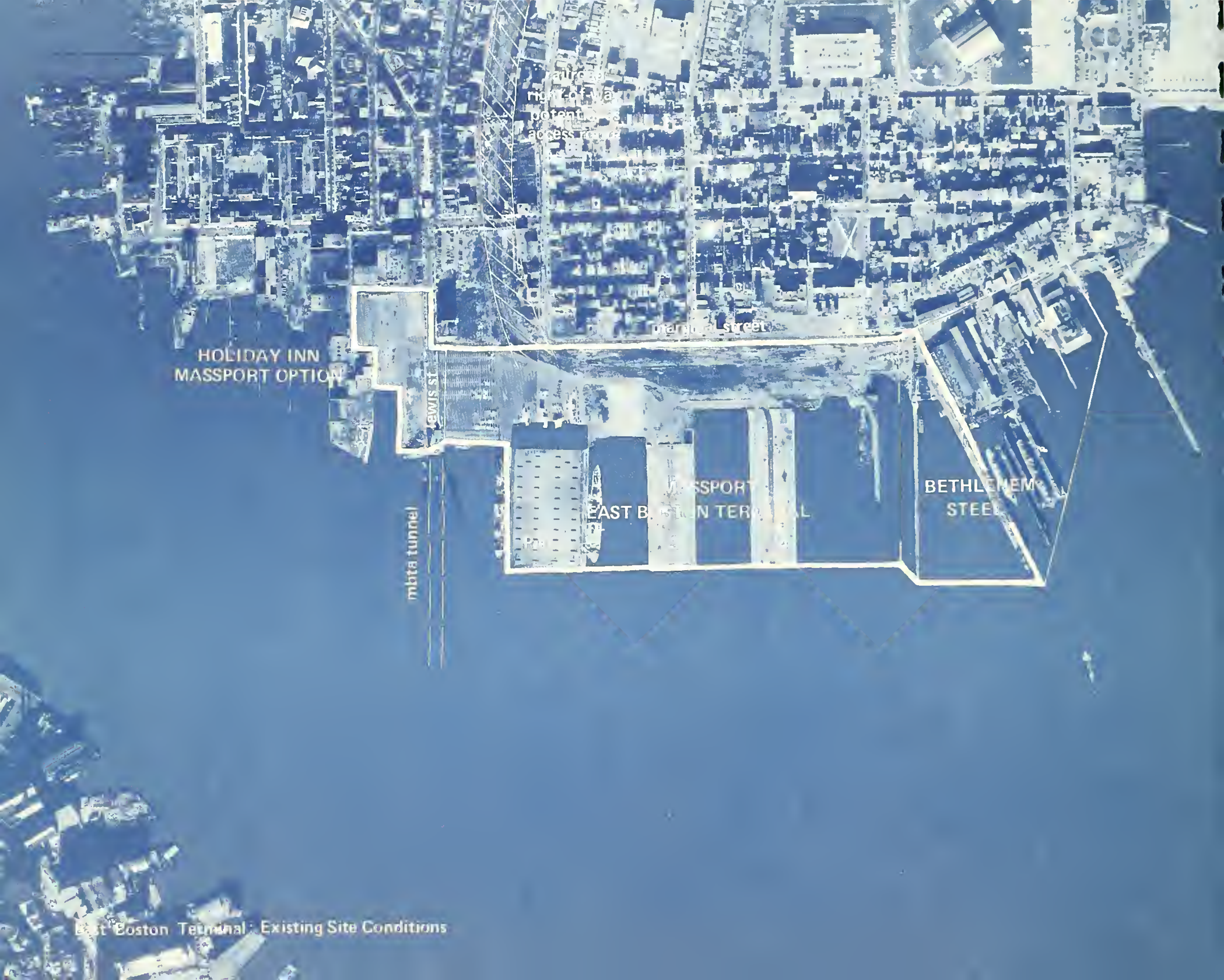
The existing land use of this area along the narrow Reserved Channel includes an oil storage facility and a large Boston Edison power plant. The MBTA also has a power generation plant in this area. These established uses would prevent development of a container terminal in this waterfront area.

Castle Island

The Castle Island site is presently owned by Massport, and a substantial portion is under long-term lease to Sea-Land Services Inc. as a container terminal solely for their shipping purposes. Although new container cranes of any current design would seriously intrude into the airport clear zones, this site will be further evaluated because it is owned by Massport and offers substantial marginal berthing with adjacent flat backland.


mystic terminal
east boston terminal
naval annex/ army base
castle island
EVERETT
CHELSEA
CHELSEA RIVER
BOSTON
SOUTH BOSTON
LOGAN INTERNATIONAL AIRPORT
WINTHROP
TED STATES - EAST COAST
MASSACHUSETTS
ON INNER HARBOR
ANCHORAGE AREAS

3 FOUR SITES IN DETAIL



East Boston Terminal: Existing Site Conditions

EAST BOSTON SITE

Existing Site Conditions

The entire site in East Boston presently being considered for use as a new container terminal is owned by Massport. It is bounded by Lewis and Marginal Streets to the west and north, by the Bethlehem Steel Ship Yard to the east. The present land area is slightly less than 35 acres. The area within these limits is generally flat; however, the ground surface slopes fairly steeply to above Elevation 60 across Marginal Street.

Three large finger piers, commonly identified as East Boston Pier Nos. 1, 3 and 4, lie within the site limits. Pier No. 1 is the newest pier in the Port of Boston and is in very good structural condition. The concrete deck is supported by pipe piles. A transit shed of about 198,900 square feet is located on the pier and is surrounded on the outboard sides by 25 foot wide aprons. Pier Nos. 3 and 4 both consist of timber and concrete decks founded upon timber piles and are in relatively good condition. Transit sheds previously located upon these piers have been removed, leaving them clear.

A portion of the area behind the piers is paved and is currently used for miscellaneous storage. There are no specialized container handling facilities at the site. When required, cargo is also stored in the open upon Pier Nos. 3 and 4. The remainder of the backland extending to Marginal Street is a little-used railyard. The site is provided with sufficient electrical and water distribution systems to serve the future needs of a container terminal.

East Boston Terminal: View From East

East Boston Terminal: View From South

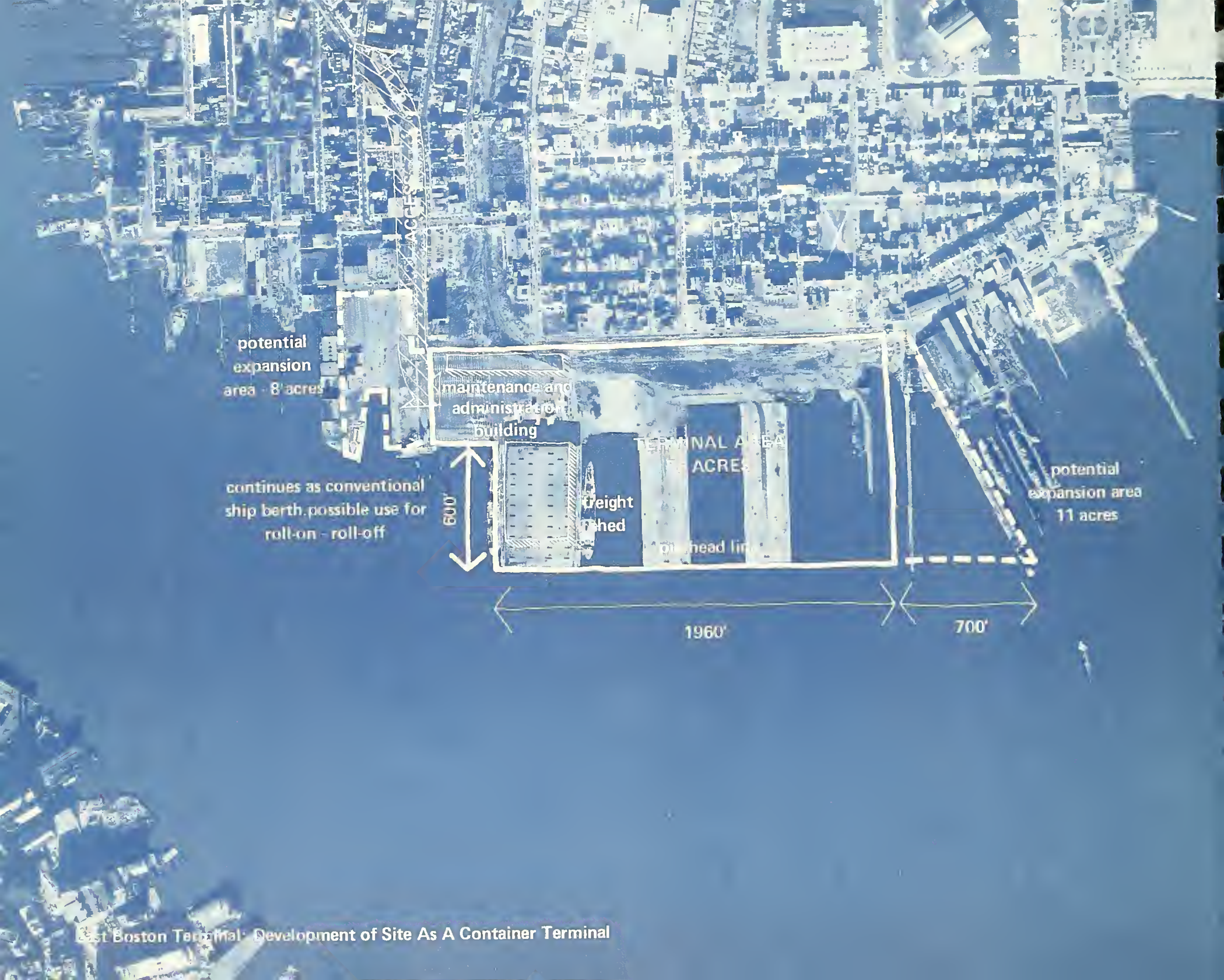
Geological Site Data

The site is situated on the southerly flank of a glacial drumlin, with an oval shape typical of those throughout the Boston Basin. Because of this feature, the subsurface conditions existing at the site should be expected to vary substantially in a north-south direction. Subsurface soil conditions across the entire site are not known, but borings have been previously drilled for the construction of Pier No. 1. These borings indicate that the surface of the bedrock at the end of the pier (about 600 feet from shore) is about 75 to 90 feet below MLW. The borings do not show the type of bedrock encountered, but it is presumed that the bedrock floor in this area consists of the Cambridge Siltstone. Bedrock at the shore line was found to be about 100 to 115 feet below MLW. Bedrock depths were found to increase towards the drumlin, indicating a moderately deep rock valley across the site.

The surface soil layer on shore consists of miscellaneous fills approximately 13 feet deep and includes sand, gravel, cinders, and rubbish. A layer of sandy silt approximately five feet thick is encountered beneath the surface fills, and the soft silt extends beyond the shore line as the harbor-bottom sediments. It would not be economical to remove these materials; therefore, some pavement settlements would be expected. These materials are underlain by the predominant deposit of soft Boston Blue Clay, with the thickness varying from 40 to 90 feet across the pier. A thin layer of hard sand, gravel and clay (glacial till) up to ten feet thick is found between the clay and the underlying bedrock.

Navigation

The site is about two miles from the mouth of the Inner Harbor, adjacent to the main shipping channel which is maintained at a 40-foot depth below mean low water (MLW). As ships pass through the Inner Harbor, they intrude into the approach zones at the southerly ends of three runways at Logan Airport. Superstructures of ships passing through the harbor could theoretically interfere with aircraft, but in practice approaching aircraft are kept at higher altitudes when shipping is present. There are no other serious impediments to navigation at this site.



East Boston Terminal: Development of Site As A Container Terminal

Future Site Development

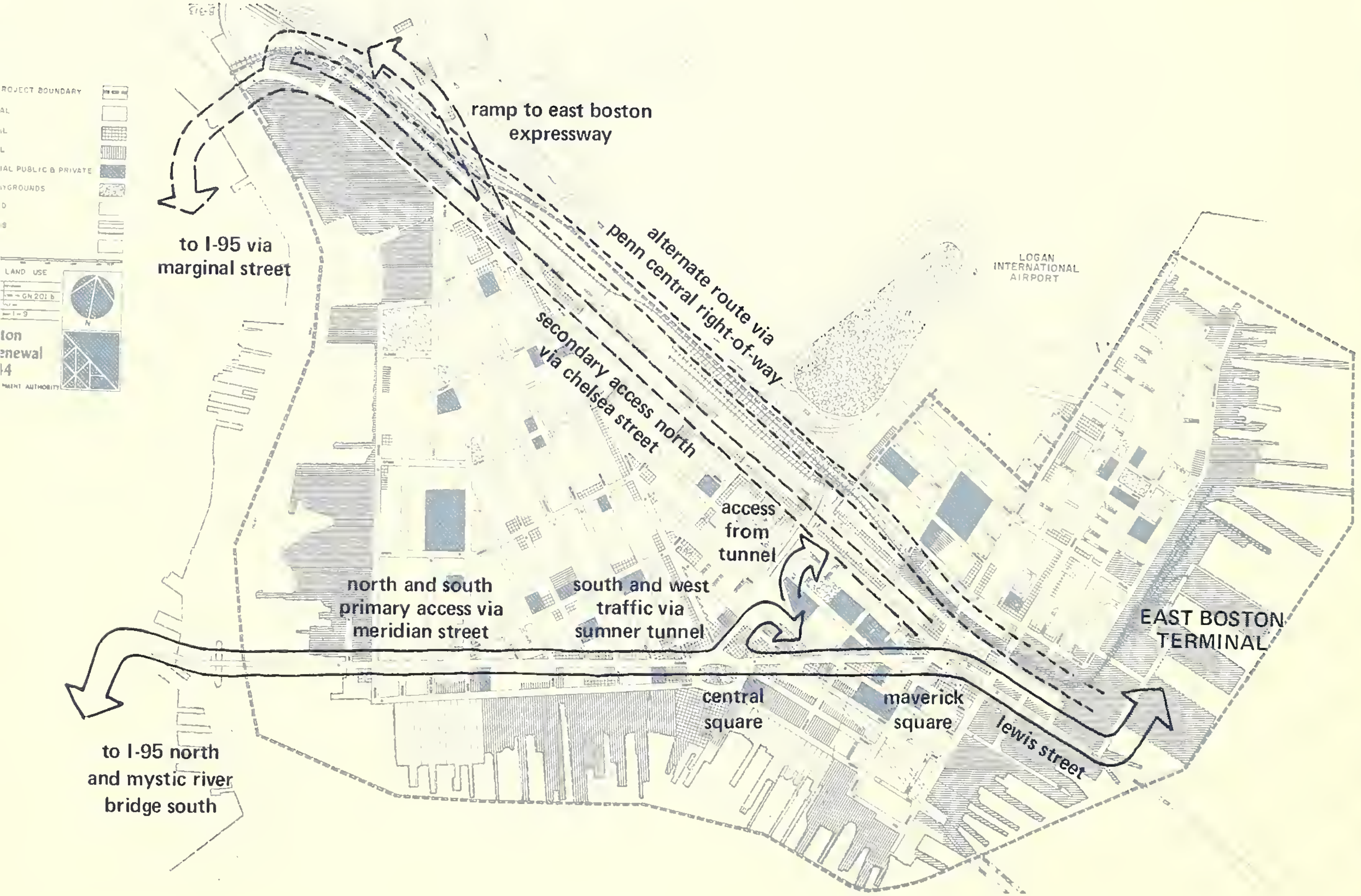
For maximum utilization of this site as a new container terminal, the entire area from shore line to the pierhead line should be filled to about Elev. 17, (MLW Datum). Pier Nos. 3 and 4 would have to be demolished and removed prior to this filling. It is important that Pier No. 1 be integrated into the new terminal without substantial change, since it is now efficiently handling conventional cargo. Filling to the proposed limits as shown would require approximately 2,000,000 cubic yards of fill and would provide a total of 56 acres of terminal space. About 1,960 feet of marginal berthing will become available along the wharf front, sufficient to simutaneously berth two large container ships. About 600 feet of berthing would still be available along the west side of Pier No. 1 for a conventional cargo ship. Landward expansion would be limited to Marginal Street, since further expansion would require the taking of residential areas.

Westerly expansion into the former 1800 Restaurant area to obtain more storage space could provide approximately eight acres. However, the MBTA tunnel extending beneath Boston Harbor to East Boston and Lewis Street extending to the waterfront restricts development.

Expansion to the east into a portion of the Bethlehem Steel Shipyard would be possible without serious disruption to shipyard operations. Practically, expansion would be limited to about 110 feet along Marginal Street. If carried out to the pier line along Bethlehem Pier No. 2, this expansion would require approximately 550,000 cubic yards of fill and would add approximately 11 acres and 700 feet of marginal berthing. The total acreage for the terminal would then be approximately 67 acres, an area sufficient for three container berths.

There is about 600 feet of berthing space along the west edge of Pier No. 1 with an existing depth of 35 feet. Dredging will be required along this berth since a dredged depth of 40 feet below MLW will be required for all future container ship berthing.

To integrate Pier No. 1 into the new terminal, the transit shed would have to be cut back at least 100 feet from the wharf front to provide for container crane travel. Additional deck reinforcement would be required to support the loads induced by the crane rails. The modified transit shed could still be utilized for handling cargo from conventional ships at the west berth, as well as to serve the new container terminal. With modification, Pier No. 1 could also be used for berthing roll-on, roll-off ships for cargo discharge directly into the yard without interference with the wharf front operations. It would be necessary to construct maintenance and administration buildings at some convenient location at the site.


ramp to east boston expressway
to I-95 via marginal street
alternate route via penn central right-of-way
secondary access north via chelsea street
LOGAN INTERNATIONAL AIRPORT
access from tunnel
north and south primary access via meridian street
south and west traffic via sumner tunnel
EAST BOSTON TERMINAL
central square
maverick square
lewis street
to I-95 north and mystic river bridge south
ROJECT BOUNDARY
LAND USE

East Boston Terminal: Access

Existing Highway Routes

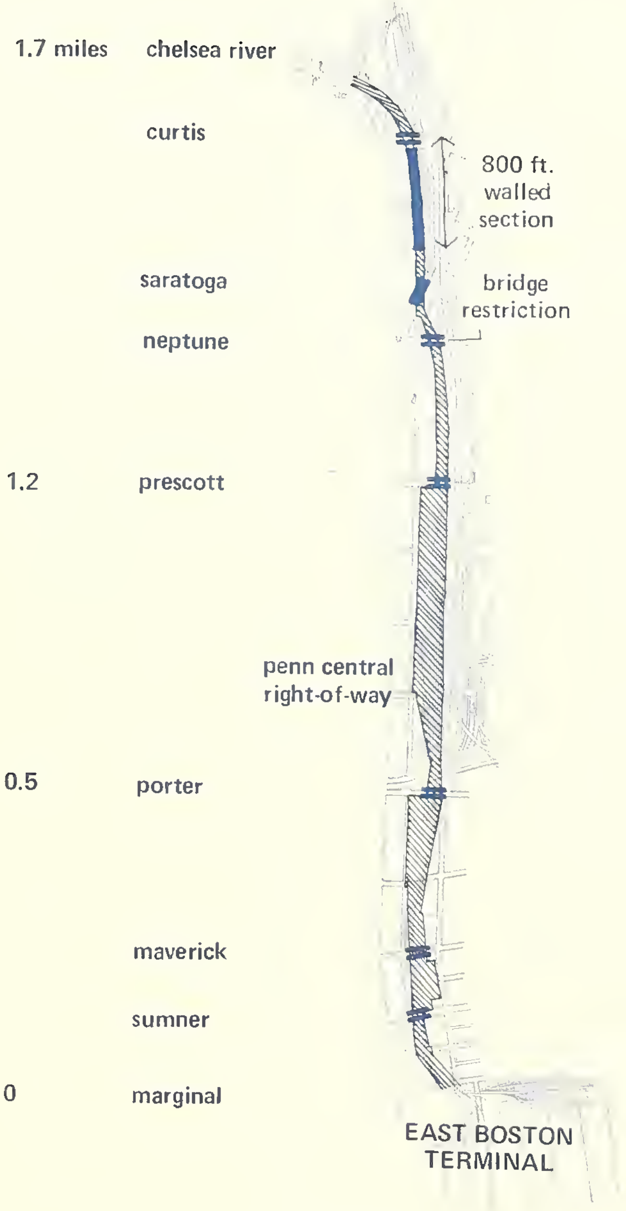
Since East Boston is virtually surrounded by water, direct vehicular access to the south and west crosses the harbor at either the Sumner and Callahan Tunnels or the Mystic River Bridge. Both facilities are congested during rush hour and have moderately high traffic volumes during the remainder of the day.

The present primary truck route for all traffic from this site would be through a mixture of residential and commercial areas around Maverick and Central Squares. From Central Square, traffic to the south and west could enter the East Boston Expressway (Route C-1) for passage through the tunnel to either the Massachusetts Turnpike (I-90) or the Southeast Expressway. Traffic bound for the north and northwest would continue along Meridian Street, across the McArdle Bridge and into Chelsea along an established truck route to the Northeast Expressway (I-95N).

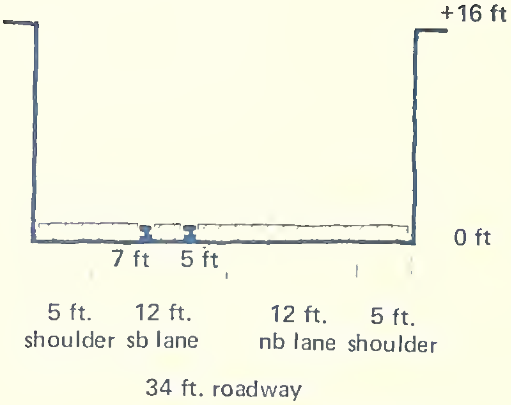
Leaving Maverick Square, Chelsea Street could also be used as an alternate, albeit less desirable, truck route. There are direct connections to and from the tunnels from Chelsea Street. If truck traffic continued along Chelsea Street, there are direct connections to Route C-l and I-95N.

Existing Rail System

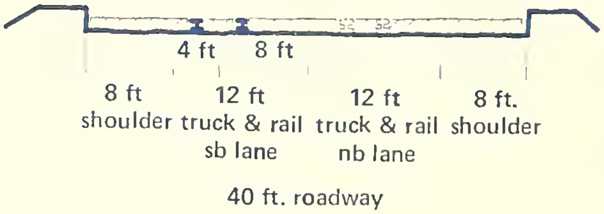
Rail service from the site could be provided by a freight spur of the Penn Central Railroad. However, the existing tracks are presently abandoned, and extensive repairs would be required to the road bed and tracks as well as to the signal system. Northbound traffic must be transfered to the Boston & Maine rail network, but this transfer is direct and not excessively time consuming. Traffic destined for the Penn Central main line to the south and west would use the inefficient Grand Junction Branch of the B&M System through Cambridge to reach Beacon Park, the nearest Penn Central classification yard. Switching of rail traffic to the south and west between rail systems necessitated by this routing is a great disadvantage in both time and expense.



East Boston Terminal: Access Via Penn Central Right-of-Way



cross section at bridges and walled section



typical cross section

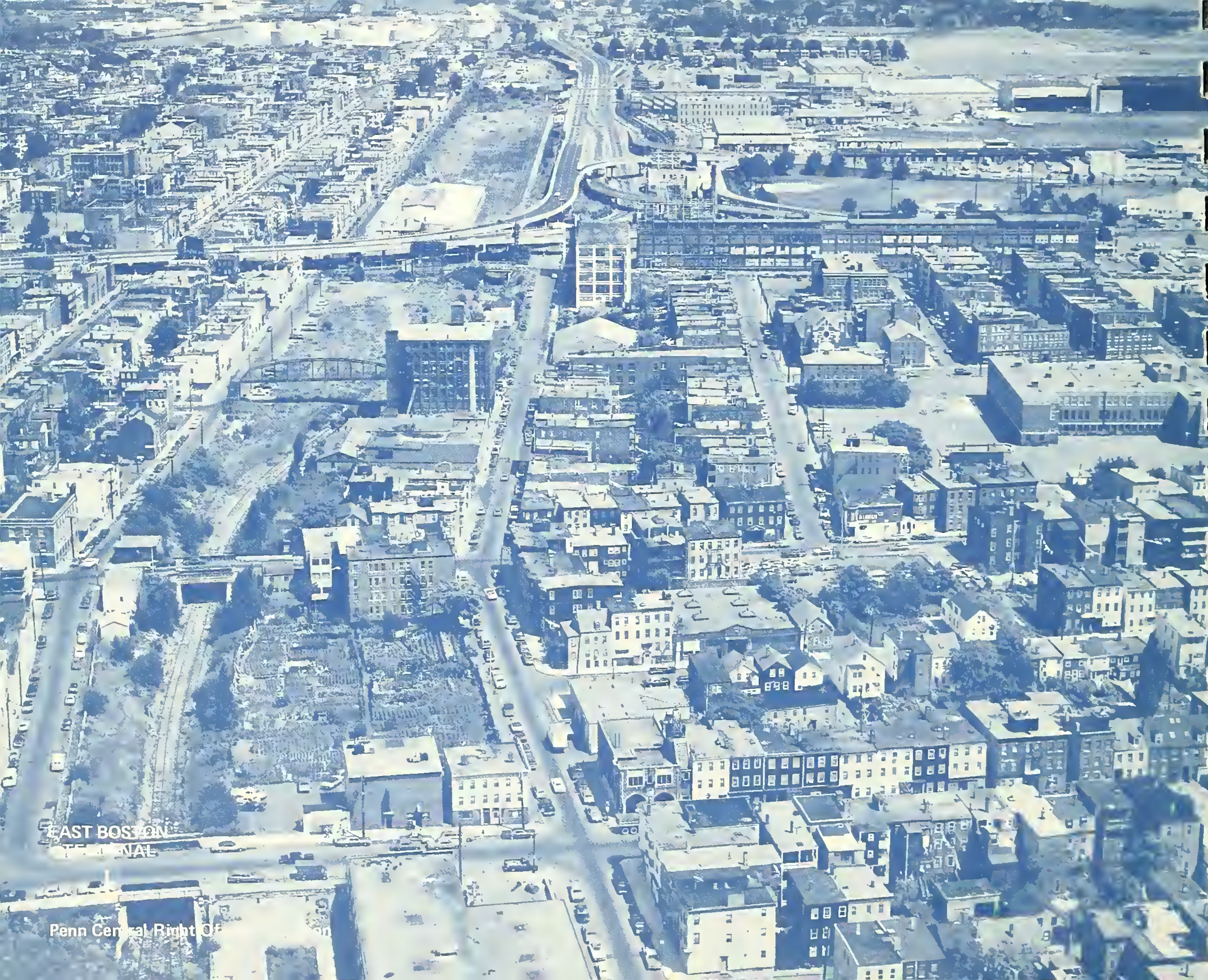
Future Traffic Routes

If the abandoned Penn Central right-of-way is purchased by Massport, a more direct access route could be developed solely for the truck and railroad traffic generated by a container terminal. The constraints in developing this route for joint use include bridge constrictions, indirect connections with major road networks, proximity to adjacent residential and industrial areas, and the intermixing of truck and rail traffic along the same route.

The right-of-way extends through both residential and industrial areas and is depressed below grade from the site to the Route C-1 viaduct structure. Truck noise will be muffled where the right-of-way is depressed. Three bridges carrying local cross traffic over the right-of-way are located between the site and Route C-1, and all have approximately 16 feet vertical clearance below the structure. The total width of open space adjacent to the right-of-way varies from about 90 feet to as much as 150 feet. The maximum width of right-of-way along this route is about 34 feet, the existing clear distance between the abutments of the existing overpasses. This width would accommodate two 12-foot truck lanes and narrow shoulders. A single track would be installed in one lane to provide for future rail traffic. This access roadway would be separated beneath the expressway viaduct as required to pass between the existing viaduct substructures.

Some existing utilities within the right-of-way may require relocation if this route is to be developed. A storm drain and several sanitary sewers are located in this area, and the bridge overpasses carry water, sewer, gas and electricity across the right-of-way.

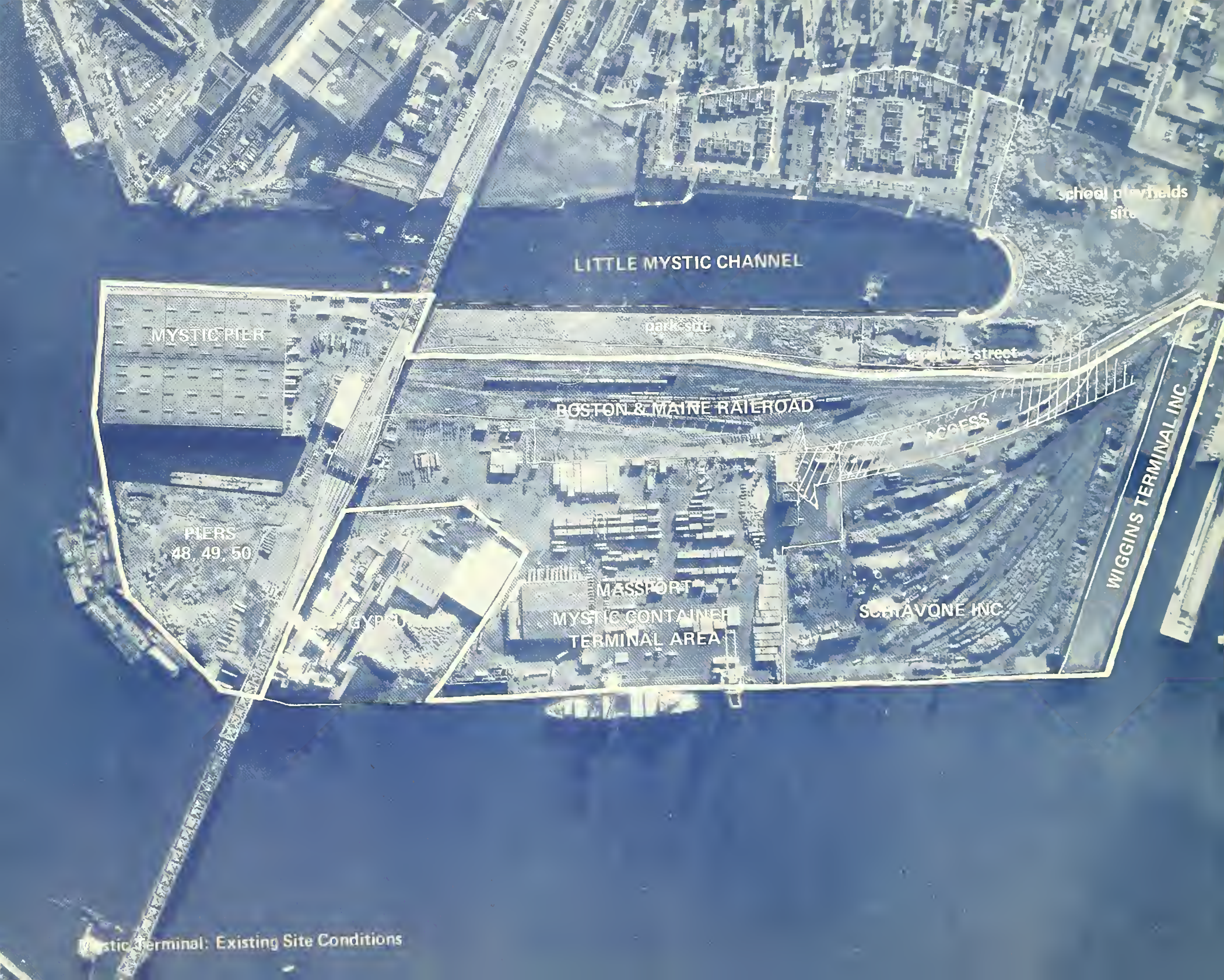
Direct connections for truck traffic onto the existing ramps along Route C-1 will be difficult to provide. A connection near Porter Street would be undesirable since heavy traffic would thus be placed on a residential street, negating the benefit of the right-of-way. A connection to the Expressway between Porter and Bennington Streets is not practical because the expressway is elevated in this area. The most practical connection would be at Chelsea Street, about 1.7 miles from the site and beyond a long and narrow walled section. The roadway template through this walled area would be similar to that proposed at the bridge overpasses near the site.


EAST BOSTON TERMINAL
Penn Central Right Of

Remote Transfer and Storage Area

Since the available waterfront area at the site is relatively small, the development of transfer facilities and a larger storage area remote from the terminal should be considered. Containers received by either truck or rail at this remote area could be transferred directly to the terminal by a conveyor system extending along the right-of-way. Some storage area would be provided at dockside in the terminal, primarily for short-term container storage. The conveyor system joining the terminal with the remote storage area could be a Massport-operated rail shuttle, or some form of mechanized roller -conveyor belt. This system would substantially reduce the impact of truck and rail traffic upon the residential and industrial areas through which the route passes.

A major problem in developing this plan may be the purchase of the storage and intermodal transfer area. A presently undeveloped but industrially zoned area of approximately 25 acres is located in Chelsea. Although there is now heavy trucking in this area, improved connections to the expressway system might be developed and constructed in conjunction with developing a transfer station, which would result in smoother traffic flow.



Mystic Terminal: Existing Site Conditions

MYSTIC WHARF AREA

Existing Site Conditions

The Mystic Wharf area extends on both sides of the Moran Terminal along the Charlestown shore of the Mystic River, and to beyond the Tobin Bridge. Covering a total of 82 acres, portions of this area are owned by the U.S. Gypsum Company and the Boston & Maine Railroad. In addition, the wooden warehouse on Pier 51 upstream of the terminal is owned by Wiggins Terminal, Inc., an area of approximately four acres.

The present area dedicated to container operations at the Moran Terminal covers approximately 22 acres. About 18 acres of land immediately adjacent to the terminal are under lease to Schiavone and Sons, Inc., for the handling and exporting of scrap metal. This extensive shipping operation should not be eliminated from the site, since relocation to another waterfront site is not feasible. However, the operation could be consolidated within an expanded container terminal by constructing new wharf and storage facilities, resulting in a combined use of the new facilities.

The B&M Railroad owns about 11 acres of rail storage yards between Terminal Street and the Moran facility, and the U.S. Gypsum complex beneath the Tobin Bridge comprises about ten acres. Downstream of the bridge, the total area encompassing Pier Nos. 1, 48, 49 and 50 consists of an additional 17 acres. In all, the ultimate expansion of this entire area north of Terminal Street and extended to the Mystic River could provide an expanded container terminal facility of over 82 acres.

The present terminal provides 900 feet of marginal berthing, with an additional 200-foot wharf extension now under construction. When finished, the largest container ship now in service could utilize this facility.

The present container terminal is equipped with two modern, high-speed container cranes: a 70 long ton capacity Hitachi crane and a 46 long ton Paceco crane. These two cranes could serve the entire length of the fully developed wharf, although an additional standby or backup crane would be desirable. There is already existing at the terminal a steel-framed transit shed with an area of approximately 42,000 square feet, and a new administration office and maintenance garage of approximately 15,000 square feet. These facilities, satisfactory for the present and immediate future, would have to be increased in size to service an expanded container terminal at this site. The existing Schiavone scrap yard is serviced by three 20-ton electric traveling, revolving gantry cranes which would have no value in a modern container facility. The present utility systems to the site could be expanded with little difficulty to serve a larger terminal.

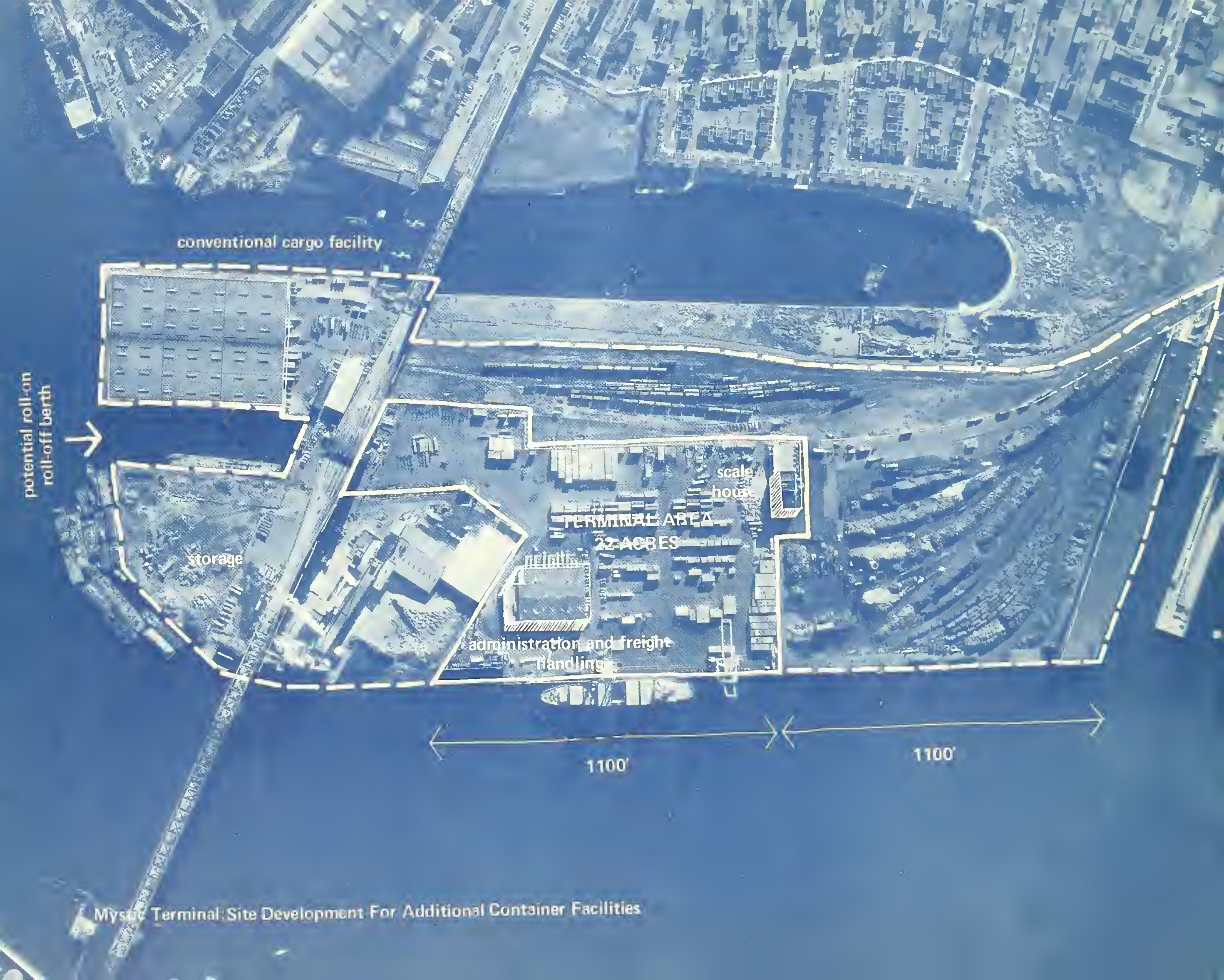
Mystic Terminal: View From North

Geological Site Data

Borings have been accomplished across the site. The soil profile developed from this data indicates a surface layer of miscellaneous coal, cinders and sand fill underlain in turn by sands, Boston Blue Clay and a glacial till. The bedrock floor consists of Cambridge Siltstone and is encountered at depths of about 80 to 100 feet. In the past, most of the site has been used as a coal storage facility, and the loads of these stored materials have randomly consolidated the underlying compressible soils.

Navigation

Of all the sites being considered the Mystic Wharf area is located farthest from the open ocean, approximately four miles from the mouth of the Inner Harbor. It is reached by traversing the main shipping channel and the Mystic River channel, maitained at depths of 40 and 35 feet, respectively. A 40-foot depth is maintained along the existing wharf for berthing purposes. The Mystic River channel could be deepened in this area to 40 feet, if future traffic were to warrant it. Passage to the site requires making several sharp turns in the main channel and at the Tobin Bridge. Since the river is too narrow to provide a good turning basin, many large ships turn at the confluence of the Mystic and Chelsea Rivers and are maneuvered backwards under the bridge to the wharf with the aid of tugs.

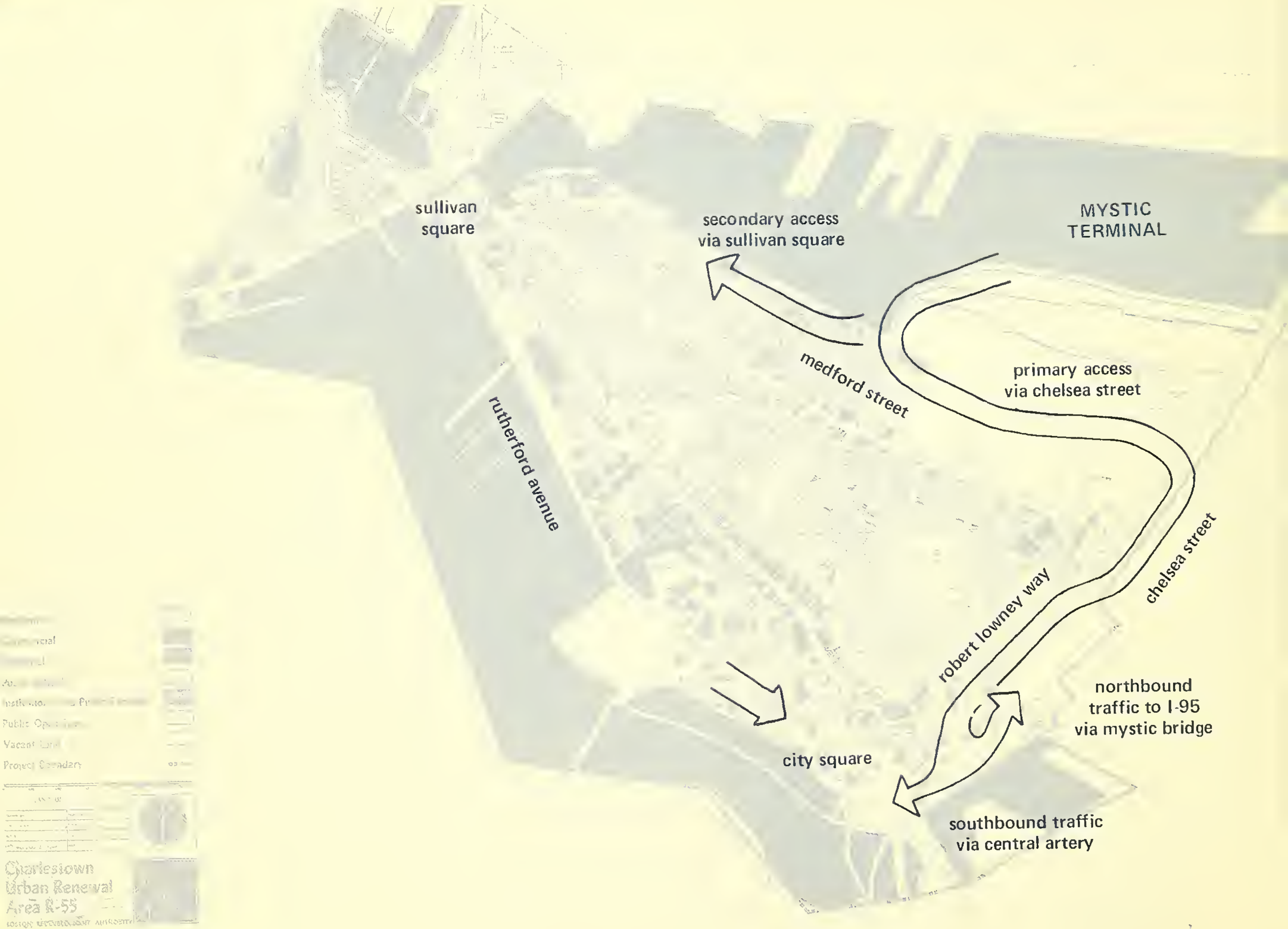

conventional cargo facility
potential roll-on roll-off berth
storage
TERMINAL AREA 22 ACRES
scale house
administration and freight handling
1100'
1100'

Mystic Terminal: Site Development For Additional Container Facilities

Future Site Development

In order to fully develop the Mystic Wharf area to its ultimate capability, expansion along the Mystic River would require the acquisition and conversion of the area now being utilized for scrap metal shipping. For maximum expansion of the container terminal along the waterfront, the Wiggins Terminal on Pier 51 should also be acquired. If the entire river frontage west of U.S. Gypsum property was developed, a total of 2,200 feet of wharf would be provided, enough for berthing two large container ships simultaneously. Downstream extension of the terminal by acquisition of the U.S. Gypsum complex would extend the berthing capability by another 600 feet.

An expanded facility at this site could not be efficiently operated unless sufficient backland for container storage was also developed at the same time. This would require acquisition of the B&M property along Terminal Street. Additional land beyond the Tobin Bridge could be easily converted to container storage (but not for marginal berthing) by bulkheading and filling at Pier Nos. 48, 49 and 50. With the ultimate development of the total area to approximately 82 acres, this would be the equivalent of a four-berth operation. The waterfront area between this area and existing Mystic Pier No. 1 could serve as a berthing area for roll-on, roll-off shipping.

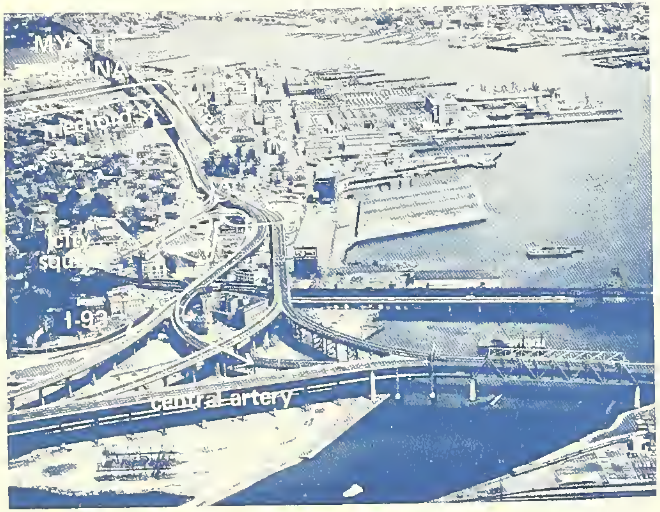

sullivan square
secondary access via sullivan square
MYSTIC TERMINAL
medford street
primary access via chelsea street
rutherford avenue
chelsea street
robert lowney way
northbound traffic to I-95 via mystic bridge
city square
southbound traffic via central artery
Commercial
Vacant Land
Project Boundary
Charlestown Urban Renewal Area R-55

Mystic Terminal: Access

Existing Highway Routes

The Mystic Wharf area is conveniently located to the regional highway network. The I-93 interchange near Sullivan Square provides for direct movements to the north. Traffic to and from the south and west can reach the Southeast Expressway and the Massachusetts Turnpike by using the Central Artery through downtown Boston. An alternate route for westbound traffic to the Massachusetts Turnpike extends along I-93N to Route 128. Northbound movements could alternately use the Revere Beach Parkway to I-95.

Since Charlestown is a residential area surrounded by industry, local truck routes are generally located near the perimeter of these residential areas. Access to the Mystic Wharf area is provided from Medford Street which is only 40 feet wide. Present average daily traffic volumes along Medford Street range between 3,000 and 5,000 vehicles, with truck traffic comprising a significant percentage. Direct traffic to and from the north can proceed west along Medford Street through a mixed industrial area, through Sullivan Square and onto I-93, a distance of only one mile. The major truck route for southbound and westbound traffic can proceed east along Medford Street to Chelsea Street, and then through City Square to the Central Artery. The length of this route is about 1.7 miles. However, the present geometric design of the entrance and exit ramps in City Square to the Central Artery is poor. As an alternate, this traffic may also proceed west along Medford Street through Sullivan Square to Rutherford Avenue, and then to City Square and the Artery. This alternate route is about three miles long.



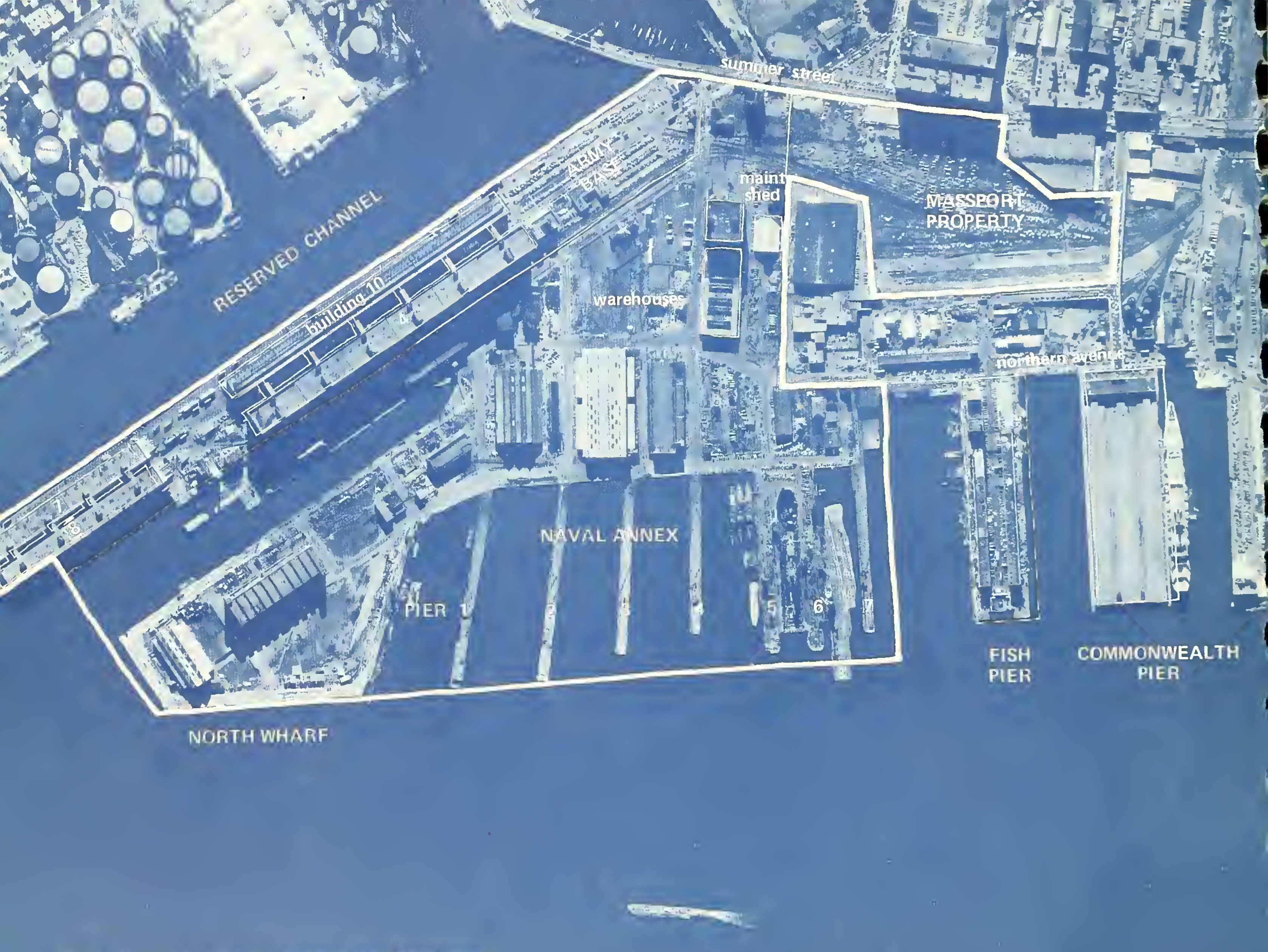
Mystic Terminal: Proposed Access to Expressways

Future Traffic Routes

Improvements for truck access to the highway network are dependent on two separate projects. The first, in City Square, would be to construct new entrance and exit ramps to the Central Artery. These improvements would be of significant benefit to automobile traffic as well as for trucks. The second project would be the construction of a low-level bridge over the Little Mystic Channel, near the site of the old Chelsea Street Bridge. With this new bridge, truck traffic to and from the site would be diverted from the residential sections along Medford Street, and the distance from the terminal to the Central Artery ramps would be reduced to less than one mile.

Existing Rail System

Local rail access is provided by the B&M Railroad through a rail yard in Somerville (about 1.5 miles away) and the West Cambridge yard (about another four miles distant). There is a connection to the Penn Central system via the inefficient Grand Junction Branch at the Somerville yard, but using this connection for switching between systems will result in time delays since there are several major street crossings at grade. If the B&M Railroad allowed container shipments direct to dockside and if cooperative agreements could be developed between the two railroads for easy switching, rail access to the Mystic River area from all destinations would be good.



Naval Annex/Army Base: Existing Site Conditions

Existing Site Conditions

This entire complex of about 227 acres is presently owned by the United States Government (184 acres at the Naval Annex and 43 acres at the Army Base) but is potentially available due to the recent (1973) military cutbacks. Because of the various legal instruments used over the years to acquire this site, various parcels may necessitate differing methods of disposition. This is the largest of all the sites being considered in this study in terms of both acreage and extent of wharf facilities.

The site is located upon the main shipping channel and the Reserved Channel, and is bounded on the south and west by Summer Street, the Penn Central Railroad, and Northern Avenue. The land portion of the site comprises 138 acres, and the water area behind the pierhead and bulkhead line represents an additional 89 acres. The land area is generally very flat, and the ground surface drains towards the harbor.

There are five abandoned finger piers on the site, labeled as Pier Nos. 1, 2, 3, 4 and 7. Each pier is a timber deck and pile structure, and all are in very poor condition and unsafe for use. Pier Nos. 5 and 6 enclose one of the two active drydocks in this complex. Both the drydock, about 700 feet long inside the caisson, and the adjacent piers are in good condition. At the east end of the Naval Annex is a man-made peninsula which includes the North and West Jetties, both of which are in good condition and are used for marginal berthing. The second drydock in the complex, about 1,200 feet long, is located near the Boston Army Base. It also is in good condition and is in active use.

The existing wharf facilities at the Army Base allow for 4,150 feet of berthing along the Reserved Channel, which is maintained to a depth of low water of 35 feet. This wharf consists of a cantilevered concrete deck structure supported by timber piles and is in good condition. It is in active use for general cargo shipping.

The Naval Annex portion of the complex has extensive warehouse and shop facilities, for the most part of steel-framed construction. Approximately 12 of these larger buildings and a number of smaller structures would be demolished to provide for either container storage or for other effective use of the site. The two multi-story warehouses near the Summer Street entrance could be retained for conversion to terminal operations, resulting in a total area of 124,000 square feet. An existing maintenance facility and shop comprising about 37,000 square feet could also be retained to serve the terminal operations. Sufficient land area adjacent to these facilities is available for expansion, if needed.

The structures on the Army Base portion of the complex are of more substantial construction than those at the Naval Annex. Many are presently utilized for both the military activities now being phased out and for commercial cargo shipping. Building Nos. 7 and 8 at the harbor end of the wharf are both three-story steel and concrete structures, each having a total floor area of 554,000 square feet. Building No. 10 is a two-story steel and concrete structure, totaling about 333,000 square feet. These three large warehouses would be very expensive to demolish. Building No. 4, used for storage and administrative functions, is an eight-story

Naval Annex/Army Base: View From East

Naval Annex/Army Base: View From North

reinforced concrete structure with a total floor area of 1,683,000 square feet. It would be equally difficult to demolish. There are other smaller buildings located at the west end of the Army Base which could provide for offices for a future container terminal.

The aprons surrounding the wharf sheds vary in width between 60 and 65 feet, considerably less than the 100-foot width desired for container operations. If this portion of the site fronting the Reserved Channel were continued in its present role as a conventional cargo facility, this would reduce the total area available for future development by approximately 42 acres, or equivalent to a "loss" of two berths.

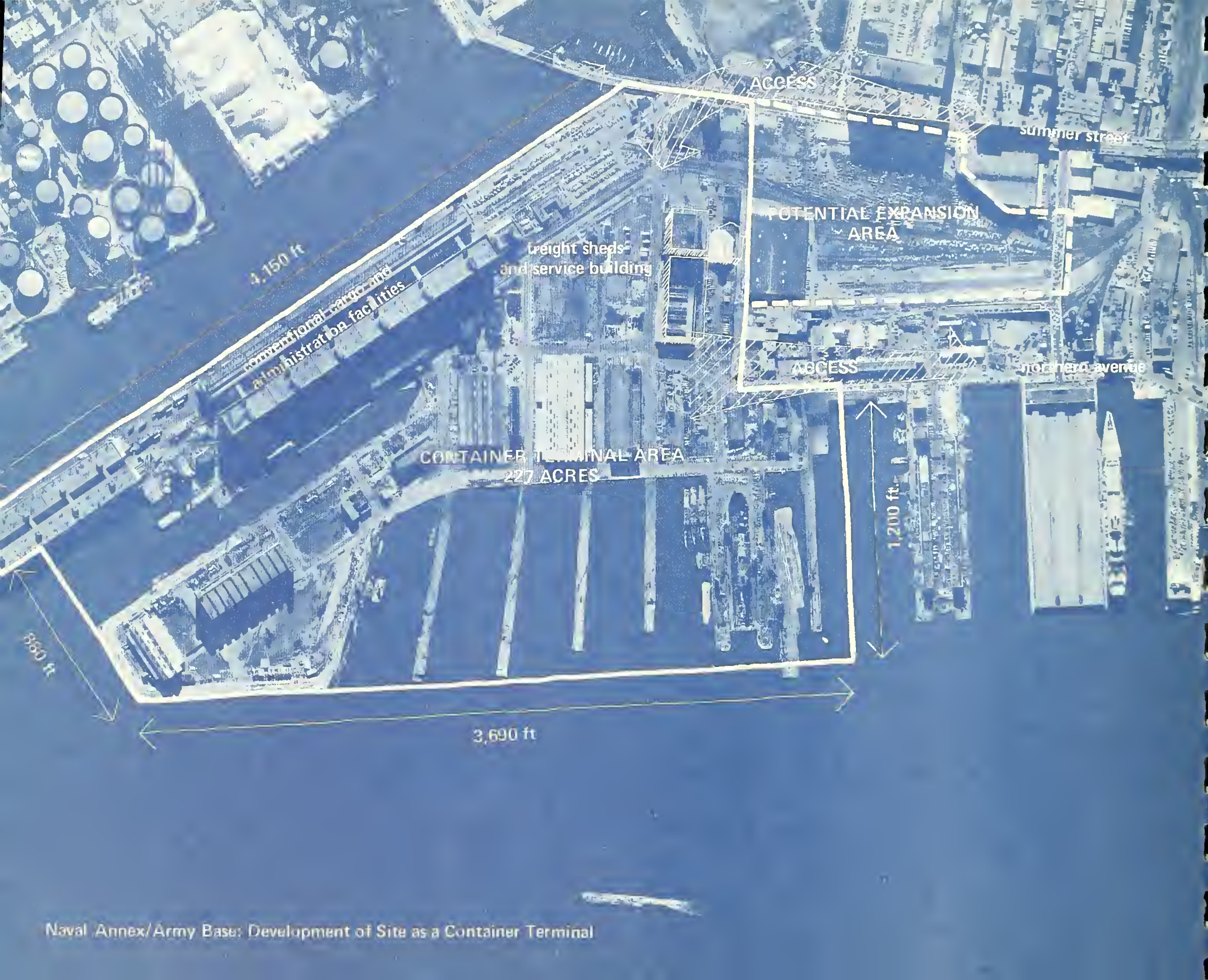
The present utilities now sufficient for a large military installation would be more than adequate for a container terminal or other associated shipping use.

Geological Site Data

Despite the developed extent of waterfront and land structures across the site, there is not sufficient subsurface data available upon which definite geological interpretations may be made. The limited boring data indicates that the depth to bedrock across the site is highly erratic, with depths varying from 11 feet to 76 feet below the ground surface. The average soil profile in the land area as can best be determined consists of up to 25 feet of miscellaneous surface fill, underlain in turn by organic silts and fine sand, Boston Blue Clay, and gravelly glacial till. The harbor-bottom sediments in the water areas consist of organic muds of varying thickness, overlying the sandy silts and clay.

Navigation

The site is less than one mile from the entrance to the Inner Harbor. It is adjacent to both the main shipping channel with its 40-foot depth and the Reserved Channel maintained at a 35-foot depth. There is ample area for ships to turn around when maneuvering for berthing at this complex. The passage to the site is straight and unimpeded, but ships destined to this area pass through the approach zones at the ends of Runways 4L, 4R and 9 at Logan Airport. Use of portions of the site for container cranes and for berthing ships would intrude into the sloping critical zones of these runways.

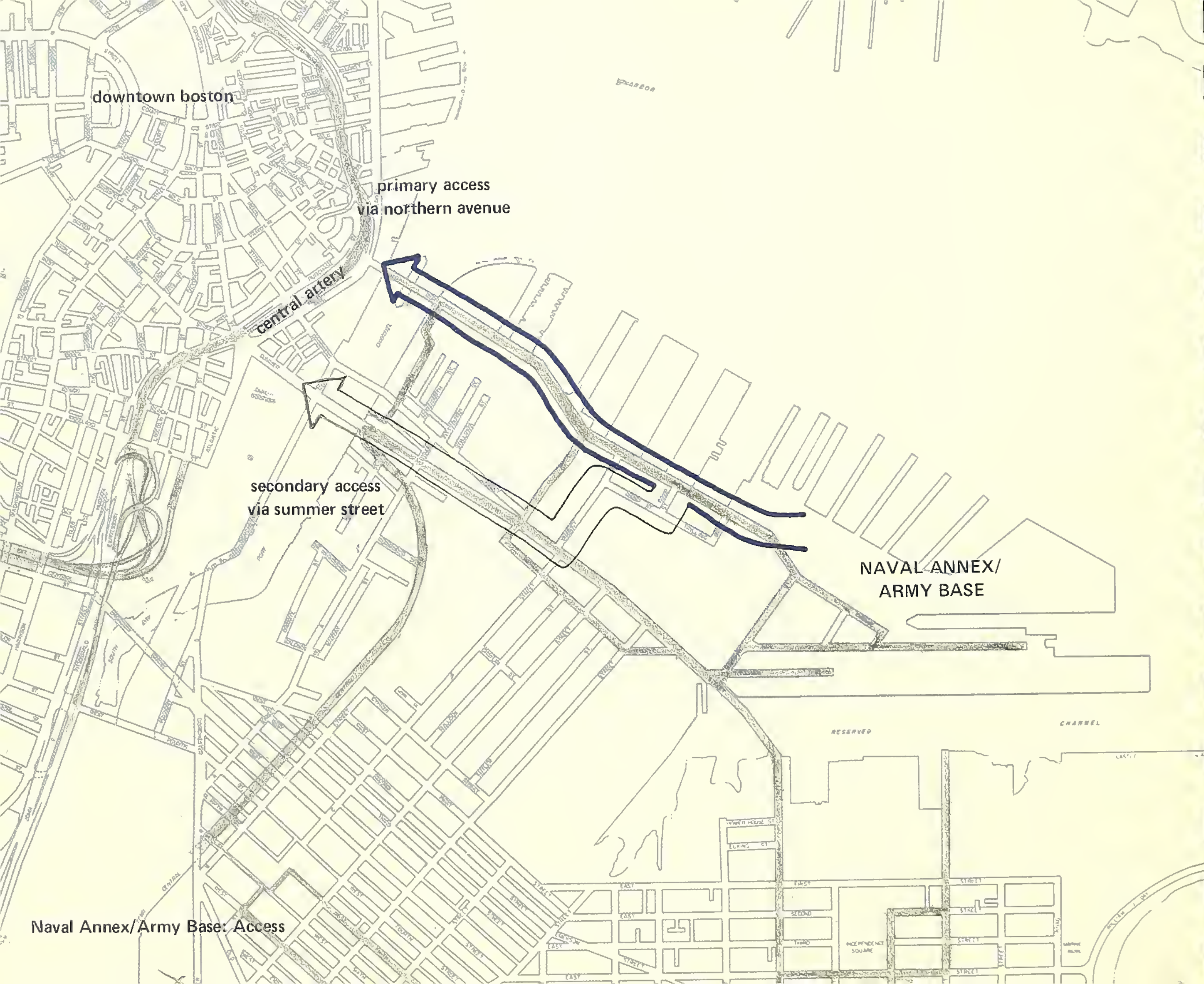

ACCESS
summer street
POTENTIAL EXPANSION AREA
freight sheds and service building
4,150 ft
conventional cargo and administration facilities
ACCESS
northern avenue
CONTAINER TERMINAL AREA 227 ACRES
1200 ft.
880 ft
3,690 ft

Naval Annex/Army Base: Development of Site as a Container Terminal

Future Site Development

In order to make maximum utilization of the portions of the Naval Annex site which would be dedicated for container operations, the area behind the pierhead line should be filled to approximately Elev. 17 (MLW Datum). The existing timber finger piers must be completely removed prior to these operations. By filling along the pierhead line to the angle point at the Reserved Channel, a section of linear marginal berthing about 3,690 feet long would be provided along the main shipping channel. This would allow simultaneously berthing of three large container ships and a smaller "average size" container ship. However, approximately 1,200 feet of this potential wharf length would be located beneath the critical zone of runway 9L requiring a low profile crane. Ships berthed in this area may intrude into this critical zone. This extent of filling would require approximately seven million cubic yards of fill. Since the existing drydocks would not be of any benefit for a container facility, they would be filled to make maximum efficient use of the surrounding area. In addition, the marginal berthing facility now totaling 4,150 feet and the wharf sheds along the Reserved Channel would still be utilized for handling general cargo.

If the ultimate development of this site to its maximum potential capacity is deemed to be excessive, then only a portion of the complex could be dedicated to terminal development, and the remainder utilized for other purposes by others. Judicious selection would be required of those areas to be used for berthing, handling and storage operations associated with a modern efficient container terminal.



Naval Annex/Army Base: Access

Existing Transportation Routes

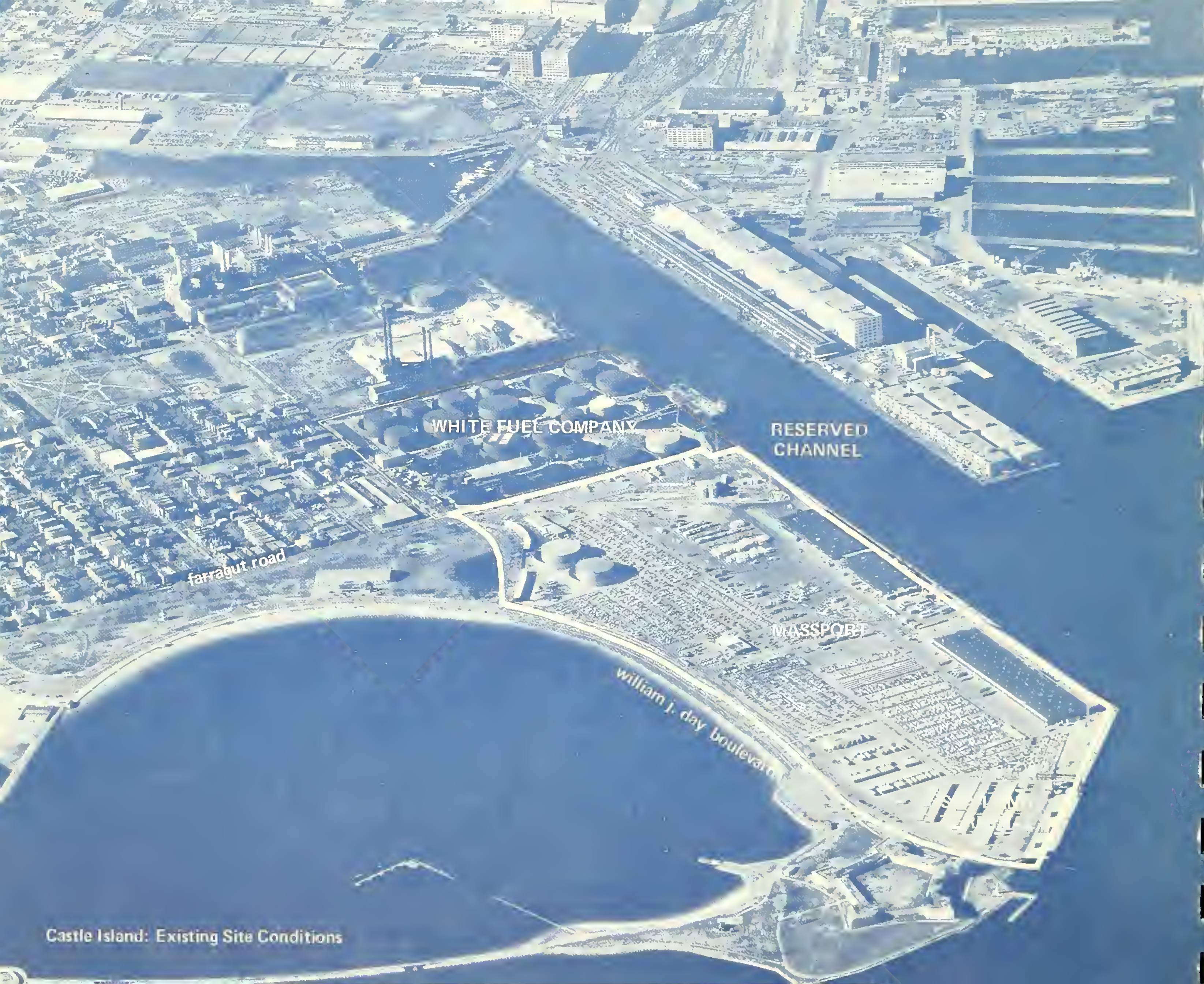
The major elements of the regional highway network are situated near the Naval Annex complex. Proximity of this site to the Southeast Expressway and the Massachusetts Turnpike provides direct access to the south and west. In addition, the major north-south routes in Central and Western Massachusetts are accessible from the Turnpike, as are the circumferential routes around Boston (Routes 128 and I-495). The Central Artery provides direct access to the north via I-93 and the Mystic River Bridge to I-95.

The Naval Annex is located within an area of industrial, warehousing and commercial facilities which already generates truck traffic and which acts as a buffer zone between the major residential areas in South Boston and the harbor. Traffic to and from the site may utilize one of three connections to the regional network. Vehicles can proceed along Summer Street to Dewey Square, for either a northerly connection with the Central Artery opposite Northern Avenue or a connection onto the Massachusetts Turnpike or the Southeast Expressway for movements to the south or west. Summer Street is a high capacity facility (3,300 vehicles per hour - green signal time) with 36-foot wide roadways in each direction. Northbound traffic could also use Northern Avenue directly to the Central Artery. Northern Avenue is a harbor-front route passing the Fish and Commonwealth Piers, and other industrial and commercial facilities. Despite the wide roadway, its effective travel width is often reduced to only one lane in each direction due to uncontrolled vehicular flow and parking.

Indirect routing for both north and south movements can also be provided by using the existing local street system through South Boston to the Broadway Bridge. These local streets now pass through warehousing and other industrial areas which are generators of truck traffic. The Broadway Bridge provides for one lane of undivided traffic in each direction. From this point, movements to both the south and the north can be made on the Central Artery.

Due to the volume of trucking already using the local street network, plans have been discussed for a new route connecting Summer Street to Northern Avenue. This would be particularly useful to divert northbound truck traffic to Northern Avenue and then to the Central Artery. Major improvements would be required along Northern Avenue, including the renovation of the Fort Point Channel Bridge and a more efficient connection to the Central Artery. The capacity of Northern Avenue can be increased by repaving the surface and by features to better channelize traffic. More efficient southbound movements could best be accomplished by improving the local street system to the Broadway Bridge, particularly along both Summer Street and West First Street, and at intersections where trucks must now turn.

Local rail access is provided to South Boston by the Penn Central Railroad. However, the Dorchester-Shoreline branch which provides direct service to the south has no connection for direct rail movements to the west or north. Traffic must first move southerly and then be rerouted in a northerly direction to connect with the main line at Framingham. This circuitous route causes time delays, resulting in increased costs. Northbound rail traffic to be switched to the B&M system utilizes an even more circuitous routing through Beacon Park, for ultimate connection via the Grand Junction Branch to the north.



Castle Island: Existing Site Conditions

CASTLE ISLAND

Existing Site Conditions

The Castle Island area is the first waterfront location of significance made upon entrance into Boston Harbor. This site, presently owned by Massport, comprises about 101 acres and is situated immediately adjacent to both the main shipping channel and the Reserved Channel. Its land boundaries are Castle Island Park, William J. Day Boulevard, and Farragut Road. Because of these limits and the extensive oil tank farm located to the west of the site, there is no significant expansion capability at this site.

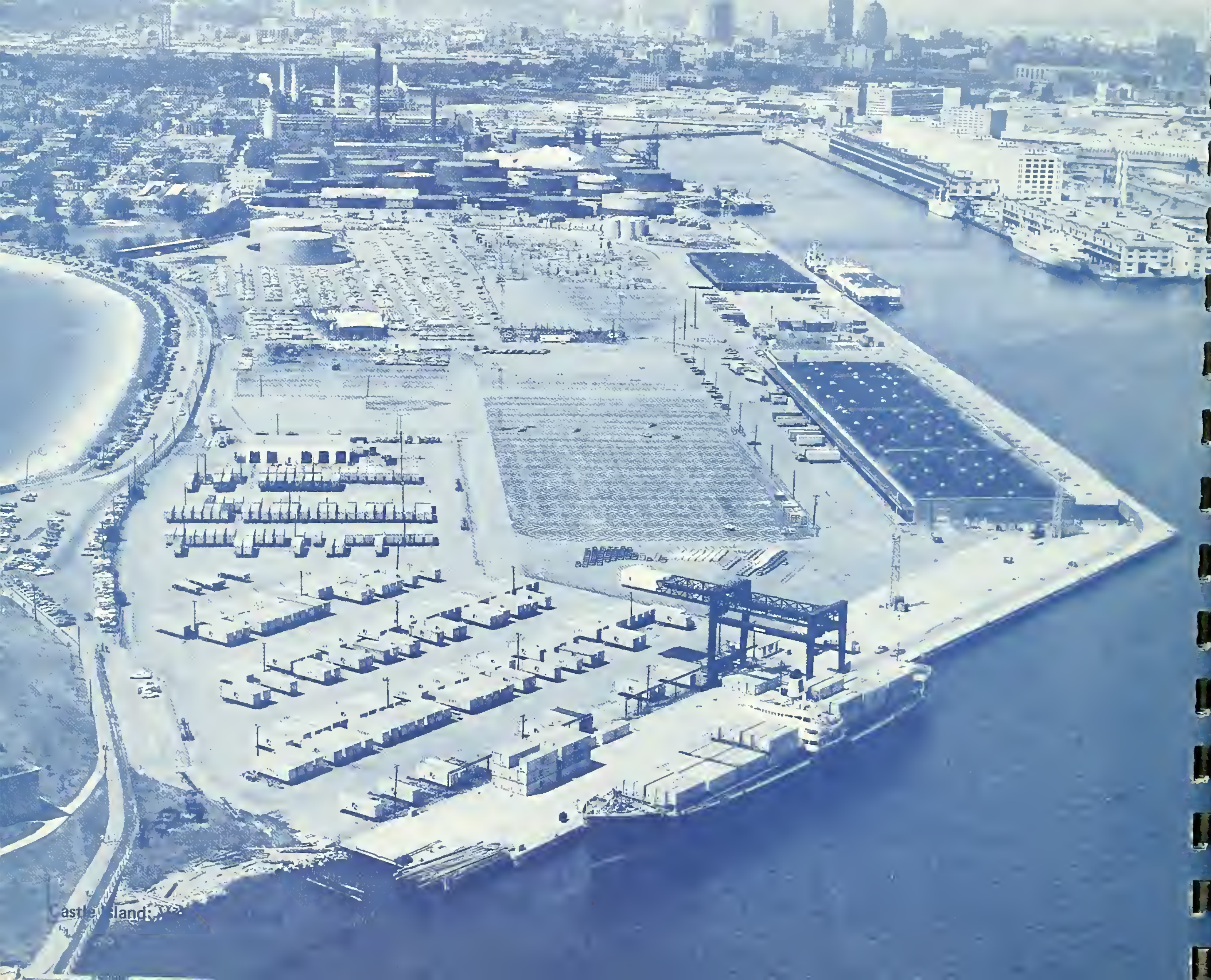
Approximately 13 acres of the easterly portion of the site is leased to Sea-Land Service Inc., and is operated as a container terminal solely for the use of Sea-Land vessels. Containers are presently handled by a 27.5 long ton low profile container crane and are also stored within this portion of the site. The remainder of the area is leased to others and is used for the handling, shipping and storage of general cargo, lumber and automobiles.

All of the site is essentially flat and paved. There are two wharves used for marginal berthing – the east wharf facing the main channel about 1,460 feet long and the west wharf along the Reserved Channel about 2,985 feet long. The depths at these berths are maintained at 35 feet. Because of the site layout, these berthing facilities cannot be extended in either direction.

There are two large transit sheds located on the site, both used for the general cargo handled by shipping berthed along the Reserved Channel. One, of wooden construction, has an area of 75,000 square feet; the other, a steel framed structure, has an area of 220,000 square feet. Due to the location of these sheds, the apron width is now limited to less than 55 feet along a significant portion of the west wharf.

The portion of the east wharf facing the main channel and now being used by Sea-Land has been reinforced to support the container crane loads. The existing utilities at the site would be sufficient for a future container terminal.

Except for the portion now being used by Sea-Land for container operations, future development of this site for use as a container terminal must consider the critical approach zones extended southward from runways 4L and 4R of Logan Airport. The center lines of these approach zones pass over the site at elevations (above MSL) of 169 feet and 84 feet, respectively. These limits establish a severe restriction for the use of this portion of the site because of the height requirements for container cranes. Low profile cranes having heights of about 110 feet above the wharf level are practical, but they would still intrude into the critical zone for approximately 2,100 feet (about 47 percent) of the total berthing length available along the main and Reserved cahnnels.



Castle Island: [illegible]

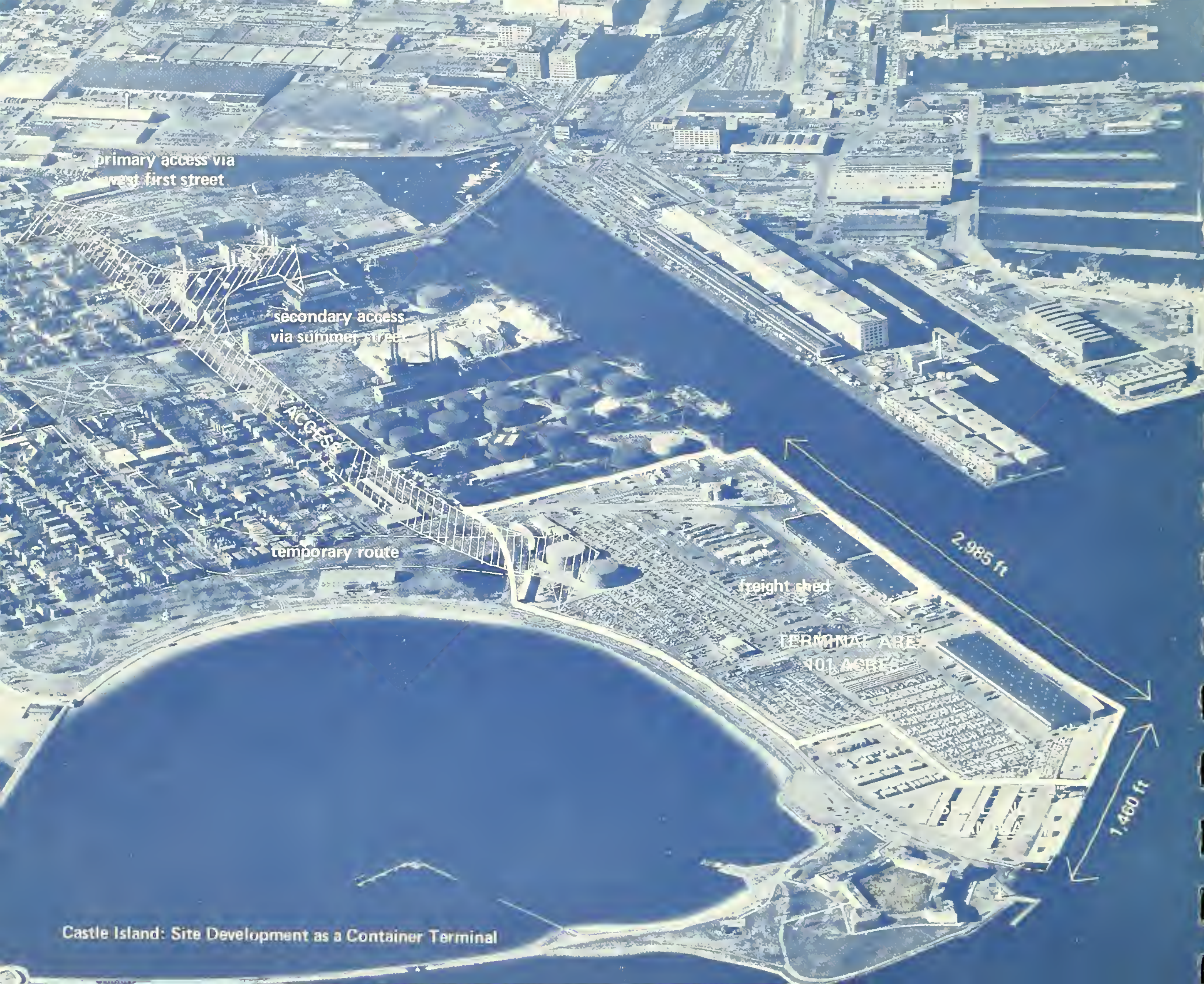
Geological Site Data

Available subsurface soil data across the site is limited. However, those borings which have been drilled at the westerly end of the site indicate approximately 25 feet of miscellaneous fill overlying deposits of sands and gravels, silts, and clays, with bedrock reported at a depth of about 92 feet. At the easterly end, borings indicate a similar soil profile, with the bedrock depth about 83 feet.

Navigation

Since the site is located at the mouth of the Inner Harbor, it enjoys the full potential of all the advantages of the harbor. The main channel is 1,200 feet wide, and is maintained to depths of 35 feet on the inboard half and 40 feet for the outboard run. An area north of the main channel is available for use as a turning basin, if required by the vessels berthing at this site.

The Reserved Channel along the west wharf is only 600 feet wide and is maintained at a depth of 35 feet. Because of this relatively narrow width, tugs are required in the berthing of ships along this wharf.



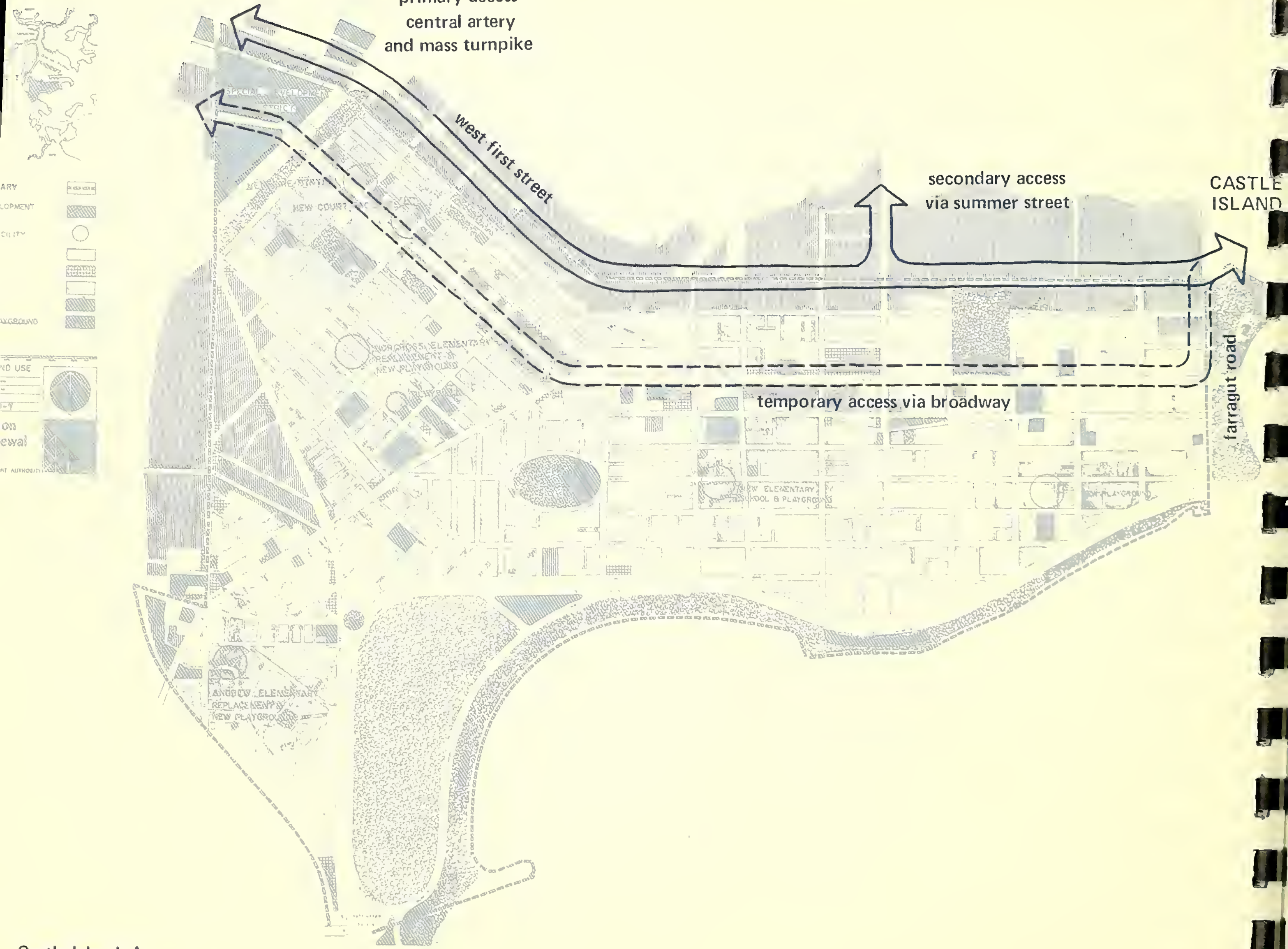
Castle Island: Site Development as a Container Terminal

Future Site Development

The transit sheds now located along the west wharf facing the Reserved Channel could be reduced in width, thus providing an apron sufficiently wide to allow the use of container cranes along that portion of the wharf. With these modifications, the remaining portion of the transit sheds would only be about 225,600 square feet. Although this area may be sufficient for use as a freight consolidation shed, its location may be adverse to the most efficient site development, and new facilities should be constructed.

Because of the angular orientation of the two wharves facing the main and Reserved Channels, duplication of cranes would be required unless the crane rails were set on a curve or a turntable was installed at the angle point. The minimum radius for a curved crane rail installation would be approximately 300 feet.

Since the configuration of even a low profile container crane would extend into the critical approach zones extended from the Airport, waivers would be required from appropriate federal and state aviation agencies in order to expand the existing facilities. The rules governing flight approaches cannot be expected to be substantially changed to allow intrusion of the necessary heights of container cranes into the approach zones. A significant portion of the Castle Island site would, therefore, not be available for container operations, thus severely limiting the flexibility of berthing container ships along the existing wharves.


primary access
central artery
and mass turnpike
west first street
secondary access
via summer street
CASTLE
ISLAND
farragut road
temporary access via broadway
SPECIAL DEVELOPMENT DISTRICT
NEW COURT
NORCROSS ELEMENTARY REPLACEMENT & NEW PLAYGROUND
NEW ELEMENTARY SCHOOL & PLAYGROUND
ANDREW ELEMENTARY REPLACEMENT & NEW PLAYGROUND

Castle Island: Access

Existing Transportation Routes

Regionally, Castle Island has the same advantages for both rail and truck transportation as does the South Boston Naval Annex. The Penn Central Railroad provides local access to its South Boston yards (about 1.4 miles away) which then connects with the Dorchester-Shoreline route to the south. Rail movements to the north and west require circuitous switching to the B&M Railroad system through the Greater Boston area.

Truck traffic generated from Castle Island uses the same local routing to the regional highway network as would traffic from the Naval Annex. The major truck route for all movements from the site is along East First Street. Traffic to and from the north and west would turn off East First Street onto Summer Street, and then proceed through Dewey Square area to use either the Central Artery or the Massachusetts Turnpike. Movements to both the south and west can use First Street to cross the Broadway Bridge, then onto the Southeast Expressway to reach Routes 3 and 128. An alternate route for northbound traffic movements is provided by using Summer Street to Northern Avenue, and then onto the Central Artery.

Future Traffic Routes

Future truck access to and from Castle Island will essentially follow the already established routes through the City. However, these access routes could be enhanced by improvements and widening of First Street, particularly between the site and Summer Street and near Broadway. Improvements near the Broadway Bridge would result in more efficient direct connections for southbound movements onto the highway network. Northbound traffic would be aided by construction of a connector road extending between Summer Street and Northern Avenue, which would then provide more direct access to the Central Artery.

4 THE NEW TERMINAL

THE NEW TERMINAL

Although each of the four sites considered as a potential location lends itself to development for future container terminal operations, all but one have decisive overriding circumstances which would prevent such development.

When the current construction at the Mystic Public Container Terminal is completed, there will be 1,100 feet of linear berthing (equivalent to a two berth facility). A facility of this size would nominally require at least 45 acres for most efficient storage and operations. Obviously the expanded facility, presently limited to 22 acres, requires more back land to maximize its potential. If this area was to be further expanded to provide the projected future requirements for an additional two berth facility, a total of about 85 acres of land would be required. This could be accomplished only by using the entire area available north of Terminal Street and extending to the Mystic River. It would require the acquisition of the U.S. Gypsum Company, the Boston & Maine Railroad yard area, the Wiggin Terminal at Pier 51; the consolidation of the Schiavone scrap operations; and the filling of Pier Nos. 48, 49 and 50 for container storage. Such a proposal would be impractical and cannot be recommended. It is strongly recommended, however, that the B&M property be acquired as soon as possible in order to develop 11 acres of sorely needed storage area for the existing Mystic facility. Futher consideration should be given to possible consolidation and/or joint usage of the areas now utilized for shipping scrap, in order to provide the 45 acres needed for optimum operation of the existing two berth terminal.

The Naval Annex/Army Base site is not recommended for development as a container terminal for two reasons. First, land acquistiion would involve a considerable capital expenditure for this property, which could have a value as high as $100,000 per acre. Secondly, there will be strong local pressures during disposition for this property to be developed for tax producing, job-intensive uses. The procedures to be followed in the actual disposition of the property are uncertain but will no doubt cause lengthly time delays. Since there is immediate need to begin planning and design for a new container terminal, the associated time delays and uncertainties related to acquisition of this site are unacceptable.

Castle Island must be rejected because the existing airport approach zone restrictions prevent further development of the site adjacent to the existing Sea-Land container facility, even with low-profile cranes. It is not recommended that the Sea-Land operation be displaced, and in any event the practical berthing capacity at the site is limited to 700 feet, a length insufficient for the additional new two berth operation.

The East Boston site is recommended as the only logical site capable of satisfying the projected requirements for an additional two berth container facility. This property is wholly owned by Massport and is presently zoned and utilized for waterfront operations. The minimum facilities should provide a total land area of at least 45 acres and a marginal berthing capability of at least 1,700 linear feet. Development of this site would continue to provide a berth for conventional cargo as well as for future roll-on, roll-off shipping. It is recommended that the entire site of 56 acres, extending from the pierhead line to Marginal Street, be developed to allow a total of 1,960 feet of new marginal wharf for both container facilites and general cargo operations. The existing freight shed sould be cut back to allow for full travel of container cranes along the wharf. In order to made this site a more usable facility, it is strongly recommended that the existing Penn Central right-of-way from the site to Chelsea be acquired and developed as a combined truck and railroad access route. This will improve the traffic flow generated from a new facility and will greatly minimize community impact. In addition, serious consideration should be given to the purchase of additional property in Chelsea at which a remote transfer and storage facility could be developed, either at this time or in the future. An estimate of the probable cost of construction of this proposed facility, including right-of-way development, is included in this report.

Proposed Development of East Boston Site from Pierhead Line to Marginal Street

Item	Units	Qty.	Unit Cost	Total Cost
1. Demolition of Existing Structures				
Remove Esisting Buildings	CF	1,207,000	$ 0.05	$ 60,375.00
Remove Esisting Timber Piles and Platform	SF	398,000	1.00	398,000.00
Remove Bit. Rds. over Concrete Base	CY	11,500	3.00	34,500.00
2. Clear Site (Existing Land Area)	SY	103,500	0.15	15,525.00
3. Dredging	CY	370,000	1.25	462,500.00
4. Steel Sheet Piling	SF	420,000	9.50	3,990,000.00
5. Rip Rap	CY	18,600	20.00	372,000.00
6. 18" Steel Pipe – Concrete Filled Piles	LF	223,500	26.00	5,811,000.00
7. Pile Load Test	EA	2	10,000.00	20,000.00
8. Earth Fill	CY	1,960,000	3.50	6,860,000.00
9. Site Improvement	SF	2,160,000	1.80	3,780,000.00
10. Concrete Deck	CY	26,000	160.00	4,160,000.00
11. Ballast	CY	9,700	6.50	63,050.00

	Item	Units	Qty	Unit Cost	Total Cost
12.	Bollards	EA	54	775.00	41,850.00
13.	Crane Rails	LF	2,000	50.00	100,000.00
14.	Cranes (40 LT cap.)	EA	2	2,400,000.00	4,800,000.00
15.	Bumpers & Fenders	EA	390	225.00	87,750.00
16.	Administration Building	SF	110,000	20.00	2,200,000.00
	Total Estimated Base Cost				$33,256,550.00
	General Conditions (4%)				1,330,262.00
	Sub Total				34,586,812.00
	Escalation 9% (over 3 years)				3,112,813.00
	TOTAL COST				**$37,699,625.00***
	Approximate cost per square foot				$17.50

---

* Does not include design fees

Estimated Cost of Development of Railroad Right-of-Way to East Boston

Item	Units	Qty.	Unit Cost	Total Cost
1. Remove Existing Rails	LF	34,200	$ 0.60	$ 20,520
2. Remove Timber Ties	EA	10,500	0.65	6,825
3. Remove Esisting Ballast and Excavate for New Roadbed	CY	26,300	3.00	78,900
4. New Gravel Sub-base	CY	12,200	9.00	109,800
5. Crushed Aggregate Base	CY	7,100	11.00	78,100
6. 8″ Concrete Base 1st Pour				
a. Concrete	CY	2,050	55.00	112,750
b. Cement Finish	SF	81,100	0.15	12,165
c. Edge Form	SF	11,500	1.50	17,250
d. Reinforcing Steel	TON	145	400.00	58,000
7. 12″ Concrete – 2nd Pour				
a. Concrete	CY	2,550	55.00	140,250
b. Cement Finish	SF	81,100	0.15	12,165
c. Edge Form	SF	17,200	1.50	25,800
d. Reinforcing Steel	TON	55	400.00	22,000
8. New Rails	LF	17,100	21.00	359,100
9. New Timber Ties (8-6 Lg.) 6″ x 7″) (44,660 LF)	EA	5,250	6.00	31,500

Item		Units	Qty	Unit Cost	Total Cost
10.	6″ Bituminous Paving	SY	23,300	5.50	128,150
11.	Edge Form for Road Gravel & Bituminous (2′–0″ High)	SF	34,200	2.00	68,400
12.	30″ R.C.P. Pipe Drain	LF	9,000	11.00	99,000
13.	Catch Basins (Avg. Hgt. 10′–0″)	EA	31	600.00	18,600
14.	Excavate for Pipe Drain and Catch Basin	CY	21,300	3.90	83,070
15.	Crushed Stone Envelope	CY	7,500	7.00	52,500
16.	Tie-in to Existing Roadway	LS	1	10,000.00	10,000
17.	Lights	EA	40	1,000.00	40,000
18.	Security Fencing	LF	17,200	11.00	189,200
19.	Utility Relocation	LS	1	10,000.00	10,000
	Total Estimated Base Cost				$1,784,045
	General Conditions (4%)				71,362
	Sub Total				1,855,407
	Escalation (5% over 2 years)				92,770
	TOTAL COST				**$1,948,177***

* Does not include land acquisition or design fees.

APPENDIX

CLASSIFICATION OF OCEANBORNE GENERAL CARGOES SUITABLE FOR CONTAINERIZATION*

Categories of Cargo that are Containerizable

Prime. Generally commodities of high value, with relatively high shipping rates. These prime commodities possess those physical attributes which permit them to be efficiently packed in containers. (Note: Major physical criteria are size and the relation of weight to cubage.)

In addition, many commodities in this category are highly susceptible to damage or pilferage. Examples of prime containerizable cargoes are liquors and wines, pharmaceuticals, and nonbulky machinery.

Suitable. Generally commodities of moderate value whose shipping rates are less than those for prime commodities. These suitable containerizable cargoes have only a modest susceptibility to damage or pilferage.

Examples of suitable containerization cargoes are wood shingles, wire products and bagged coffee. Other commodities that are as suitable are those that possess a tendency toward being contaminated (bagged flour), or those that incur penalty charges (green hides and carbon black).

Marginal. Generally commodities that physcially can be placed in containers, but are of low value with low shipping rates. These marginal containerization commodities have little susceptibility to damage or pilferage.

In addition, many marginal cargoes would be difficult to containerize because of size, weight, or other packaging problems. Examples of marginal commodities are steel ingots, pig iron, and unmanufactured wood.

Categories of Cargo that are not Containerizable

Unsuitable. Generally cargoes that physically cannot be placed in a container or normally are much more efficiently carried in specialized vessels when moving in large volumes (bulking sugar carriers, floating garages, etc.). Examples of cargoes unsuitable for containerization are scrap iron, large trucks, and structural steel over forty feet in length.

Weighting Factors

Commodities Rated

Prime = 1.00 x Applicable % of Tonnage
Suitable = 0.75 x Applicable % of Tonnage
Marginal = 0.40 x Applicable % of Tonnage
Unsuitable = 0 x Applicable % of Tonnage

---

*Source: Trade Research & Analyses Section, Port of New York Authority.

Containerization Of Export Commodities

Commodity Group	Prime	Suitable	Marginal	Unsuitable
Animals and Animal Prods.				
Meat, dairy, fish and prods.	100%			
Animal oil and fat, ed.		25%	75%	
Hides, skins, fur, leather & mfrs.	25%	75%		
Animal prods., ined.		75%	25%	
Misc. animal prods.	95%			5%
Vegetable Food Prods. & Bev.				
Wheat flour		100%		
Flour and preps., misc.		100%		
Animal feeds, misc.		100%		
Vegetables, fruit & preps. (incl. nuts)	100%			
Vegetable oil and fats, ed	25%	25%	50%	
Coffee (raw or green) and cocoa beans		100%		
Liquors and wines	100%			
Misc. vegetable food prods.	75%	25%		
Vegetable Prods., Ined.				
Rubber and products	20%	80%		
Vegetable oils and fats, ined.		50%	50%	
Tobacco	100%			
Vegetable prods., ined., misc.	60%	20%	20%	

	Prime	Suitable	Marginal	Unsuitable
Textile Fibers and Mfrs.				
Natural fibers, unmfd.			100%	
Cotton and wool mfrs. & semimfrs.	100%			
Synthetic fiber and mfrs.	100%			
Textile prods., misc.	96%	4%		
Wood and Paper				
Logs, posts and R.R. ties			60%	40%
Lumber, shingles, wood cont.		100%		
Wood & Mfrs., misc. (incl. cork)	65%	35%		
Newsprint and paper base stocks		50%	50%	
Paperboard			100%	
Paper prod. & mfrs., misc.	100%			
Nonmetallic Minerals				
Bldg. cement and gypsum			25%	75%
Glass & glass and clay prods.	100%			
Brick and tile	25%	50%	25%	
Sand, gravel, clays and earths			25%	75%
Nonmetallic minerals, misc.	10%	10%	80%	
Metals and Manufacturers				
Iron and steel scrap			20%	80%
Iron and steel semifin.		25%	75%	
Fin. steel mill prods.	50%	42%	8%	
Nonfer. ores and scrap				100%
Alum. and copper, ref. and semifab.	50%	25%	25%	
Misc. metals and metal mfrs.	50%	20%	20%	10%

	Prime	Suitable	Marginal	Unsuitable
Machinery and Vehicles				
Machinery	50%	20%	15%	15%
Machine tools	90%			10%
Vehicles, parts and access.	40%	20%	10%	30%
Rwy. equip., aircraft and watercraft and parts	20%	20%	10%	50%
Chemicals and Related Prods.				
Coal tar products	25%	50%	15%	10%
Med. pharm. and toilet preps.	100%			
Chem. specialties & misc. ind. chems.	50%	25%	15%	10%
Synthetic resins	50%	50%		
Alcohols and caustic soda		50%	50%	
Pigments and paints		100%		
Fertilizers and misc. chems.	10%	15%	25%	50%
Miscellaneous commodities	50%	30%	20%	

Containerization Of Import Commodities

Commodity Group	Prime	Suitable	Marginal	Unsuitable
Animals & Animal Prods.				
Meat, dairy, fish & prods.	75%			25%
Hides, skins, fur, leather & mfrs.	25%	75%		
Animal prods., ined.		100%		
Misc. animal prods.		100%		
Vegetable Food Prods. & Bev.				
Flour & Preps., misc.		100%		
Vegetables, fruits & preps. (incl. nuts)	60%	40%		
Vegetable oils & fats, ed.	25%	25%	50%	
Coffee (raw or green) & cocoa beans		100%		
Tea & misc. bev. preps & syrups	100%			
Spices	100%			
Sugar			10%	90%
Molasses, ed.			20%	80%
Liquors and wines	100%			
Grain, flour, feed, misc.		75%	25%	
Vegetable Prods., Inedible				
Rubber & products		80%		20%
Naval stores, gums	25%	75%		
Drugs, veg. origin	90%	10%		
Beans & seeds	10%	90%		
Vegetable oils, fats, ined.	10%	40%	50%	
Veg. dyeing & tanning mtls.		100%		
Veg. prods., ined., misc.	60%	20%	20%	

	Prime	Suitable	Marginal	Unsuitable
Textile Fibers & Mfrs.				
Natural fibers, unmfd.		50%	50%	
Cotton & wool mfrs. & semimfrs.	100%			
Burlap & jute bagging			100%	
Veg. fiber mfrs., misc.	100%			
Synthetic fibers & mfrs.	100%			
Textile prods., misc.	100%			
Wood & Paper				
Logs, posts, poles			50%	50%
Wood, unmfd., misc.			100%	
Lumber, shingles, wood conts.		20%	80%	
Wood mfrs., misc. (incl. cork)		100%		
Pulpwood, wood pulp, paper			25%	75%
Paper base stocks & newsprint			10%	90%
Paper & prods., misc.	100%			
Nonmetallic Minerals				
Bldg. cement & stone			25%	75%
Glass & glass & clay prod.	100%			
Brick & Tile		50%	50%	
Sulphur				100%
Salt, Sand, Gravel, Rock				100%
Nonmetal minerals, misc.		50%		50%

	Prime	Suitable	Marginal	Unsuitable
Metals & Manufacturers				
Iron & steel, semifin.			100%	
Finished steel mill prods.	55%	35%	10%	
Ferro alloys, misc.			30%	70%
Alum., copper & alloys, tin, ref. & semifab.		40%	60%	
Lead & zinc, crude & semifab.		50%	50%	
Ores, scrap & pig iron				100%
Metal mfrs. & metals, misc.	50%	50%		
Machinery & Vehicles				
Machinery	70%	20%		10%
Machine Tools	100%			
Vehicles, parts & acc. equip.	30%	20%		50%
Rwy. equip., aircraft, watercraft and parts	40%	30%	10%	20%
Vehicles & parts, misc.	90%	10%		
Chemicals and Related Products				
Med. & Pharm. preps.	100%			
Misc. industrial chem.	50%	25%	25%	
Pigments & paints	60%	40%		
Fertilizers		10%	25%	65%
Chem. prods., misc.	100%			
Miscellaneous Commodities	40%	50%	10%	

BIBLIOGRAPHY

New Concepts in Seaports as They Relate to the Total Transportation System in Connecticut, The Connecticut Research Commission; Soros Associates, Charles A. Maguire & Associates, Inc., Dunlap & Associates, Inc., December 1970.

Containerport Development: Port of Halifax, Task Group on the Port Metropolitan Area Planning Committee; Gibb, Albery, Pullents & Dickson, January 1972.

The Boston Seaport, 1970-1990, Boston Redevelopment Authority; E. G. Frankel, Inc., January 1970.

The Port of Boston, Mass., Part 2, Port Series No. 3, Corps of Engineers, U. S. Army; The Board of Engineers for Rivers and Harbors, Revised 1967.

Engineering Economic Study: Mystic River Development Project, Massachusetts Port Authority; Frederic R. Harris, Inc., April 1969.

Project Bosporus, Interdepartmental Student Project in Systems Engineering at the Massachusetts Institute of Technology, Spring Term, 1968, M.I.T. Report No. 21, The M.I.T. Press, 1970.

Containerization International Yearbooks, England, 1972 and 1973.

Origin/Destination Study of U. S. North Atlantic-European 1966 Cargo Movement, G. G. Sharp, Inc., New York, New York, 1968.

Waterborne Commerce of the United States: 1971 Part 1 Waterways and Harbors, Atlantic Coast, Department of the Army, Corps of Engineers.

Waterborne Commerce of the United States: 1967-1971, Part 1 Waterways and Harbors, Atlantic Coast, Department of the Army, Corps of Engineers.

1967 Census of Transportation, Commodity Transportation Survey, Area Series TC 67 - C2-33, U. S. Department of Commerce/Bureau of the Census, May 1970.

U. S. Foreign Trade, Highlight of Exports and Imports, FT 990-73-4, U. S. Department of Commerce, Bureau of the Census, April 1973.

Port of Baltimore Handbook, Maryland Department of Transportation, 1973-74.

New England Manufacturer's Export Practice and Potential, Ashton, David J., Professor of International Business, Boston University, Boston, Massachusetts, 1960

The Impact of Maritime Containerization on the United States Transportation System, Manolytics Inc., San Francisco, 1972.

Containerized Cargo on Selected Trade Routes, Maritime Administration, 1973.

Port of Boston, Rowland & McNeal, New York, New York, 1964.

Waterborne Commerce of the Port of Boston, Calendar Year 1970, Massachusetts Port Authority, July 1971.

Waterborne Commerce of the Port of Boston, Calendar Year 1971, Massachusetts Port Authority, August 21, 1972.

Gross Revenue Estimates for the Massachusetts Port Authority – Port Properties, Appendix D, CE Maguire, Inc., Waltham, Massachusetts, March 1973.

1970 Census of Housing: Block Statistics, Boston, Mass. Urbanized Area, HC(3)-108, U. S. Department of Commerce, Bureau of the Census, September 1971.

1970 Census of Population and Housing; Census Tracts, Boston, Mass. Standard Metropolitan Statistical Area, PHC(1)-29, U. S. Department of Commerce, May 1972.

1970 Census of Housing, Metropolitan Housing Characteristics, Boston, Mass., Standard Metropolitan Statistical Area, HC(2)-30, U. S. Department of Commerce, June 1972.

"Social Profile Tables" prepared by the Boston Redevelopment Authority Research Department.

1950; and 1960 Census of Population and Housing, Department of Commerce, Bureau of the Census.

Summary 1965/1975 General Plan for the City of Boston and the Regional Core, Boston Redevelopment Authority, March 1965.

"Boston – The Livable City," Boston Sunday Globe, June 24, 1973.

Toward a New Chelsea, A Program for Immediate Action, City of Chelsea, Planning Services Group, Inc., Cambridge, Massachusetts, July 1970.

Urban Renewal Plan, Murray Industrial Park Urban Renewal Area, Project No. Mass. R-126, Chelsea Redevelopment Authority, City of Chelsea, Massachusetts, August 1971.

Boston Harbor Islands Comprehensive Plan, Massachusetts Department of Natural Resources; Metropolitan Area Planning Council, October 1972.

A Pollution Survey of Boston Harbor: Park A. Massachusetts Water Resources Commission, Division of Water Pollution Control, April, 1973.

Environmental Statement – Proposed Land Fills/Dredging in Boston Harbor Adjoining Logan International Airport, Army Corps of Engineers, Department of the Army, Massachusetts Port Authority, February 24, 1971.

Transportation Facts for the Boston Region, Boston Redevelopment Authority, 1968/1969.

Surveillance and Control Project: Boston Metropolitan Highway Network, "General System Plan," Commonwealth of Massachusetts, Department of Public Works; H. W. Lochner, Inc., Boston, December, 1968.

Recommended Highway & Transit Plan, Eastern Massachusetts Regional Planning Project, Massachusetts Department of Public Works and Massachusetts Bay Transportation Authority, Octoboer 1968.

Traffic Engineering – Planning Study: Boston Naval Shipyard, Boston, Massachusetts, U. S. Army, Transportation Engineering Agency, Fort Eustis, Virginia, USATEA Report 69-24, December 1969.

Proposed Areawide Topics Plan South Boston, Massachusetts, Area No. 2, Commonwealth of Massachusetts, Department of Public Works, Tippetts-Abbett-McCarthy-Stratton, Chestnut Hill, Massachusetts, December 1970.
  Charlestown (Boston) Massachusetts, Area No. 37, October 1972.
  East Boston, Massachusetts, Area No. 38, October 1972.
  Chelsea, Massachusetts, Area No. 81, October 1972.

Draft Environmental Impact Statement, Preliminary Location Report, Program Package Evaluation Report Harbor Crossing, FHWA-MASS-EIS-28-D, Commonwealth of Massachusetts, et al, September 1972.
  Southwest, September 1972
  Northwest, January 1973
  North Shore, August 1972
  North Shore, I-95 Relocation/Revere Beach Connector, May 1972
  Central Artery, November 1972

Plan for Acquisition and Use of Railroad Rights-of-Way, Massachusetts Bay Transportation Authority; Thomas K. Dyer, Inc., December 1972.

1972 Annual Report, Massachusetts Port Authority; Howard, Needles, Tammen & Bergendoff, June 1972.

1973 Annual Report: Detailed Inspection Reports, Massport Facilities, Massachusetts Port Authority; Howard, Needles, Tammen & Bergendoff, February and March 1973.

Boring Data from Greater Boston, Boston Society of Civil Engineers, 1961.

Boring Data from Greater Boston, Journal of the Boston Society of Civil Engineers, Vol. 58, Number 1, January 1971.

Kaye, C. A., *"Preliminary Map of Bedrock Surface Under Parts of Boston, Cambridge and Brookline, Massachusetts."* (unpublished).

Bruin, Per, *Port Engineering,* Gulf Publishing Company, Houston, Texas, 1973.

Hoffmaster, Bob N., et al, *Port Maintenance,* The American Association of Port Authorities, Inc., Washington, D. C., 1970.

Kyle, John M. et al, *Port Design and Construction,* the American Association of Port Authorities, Inc., Washington, D. C., 1964.

Quinn, Alonzo DeF., *Design and Construction of Ports and Marine Structures,* Second Edition, McGraw-Hill Book Company, New York, 1972.

Rath, E., *Container Systems,* John Wiley & Sons, New York, 1973.

Preliminary Airport Master Plan Review: Boston — Logan International Airport, Massachusetts Port Authority, Aviation Department, March 1973.

Airport Layout Plan, Massachusetts Port Authority, Boston — Logan International Airport, January 1970.

An Airport Study for Boston Harbor, Course 1.09, Massachusetts Institute of Technology, May 1968.

An Investigation of a Possible Harbor Location of an Airport for Boston, class project for course 1.09, Civil Engineering Department, Massachusetts Institute of Technology, Spring 1968.

Federal Aviation Regulations, Part 77, "Objects Affecting Navigable Airspace," Department of Transportation, Federal Aviation Administration, October 1969.

Containerized Shipping and Integrated Transportation. E. G. Frankel, Proceedings of the IEEE, Vol. 56, No. 4, April 1968.

Measuring Port Sales. John L. Eyre, Arthur D. Little, Inc., Cambridge, Massachusetts; for the American Association of Port Authorities.

Waterborne Feeder Subsystems for Unitized Cargo Transportation. Arthur D. Little, Inc., Cambridge, Massachusetts; for U.S. Maritime Administration, Contract No. MA-4649, March 1970.

Oceanborne Shipping: Demand and Technology Forecast. Litton Systems, Inc., Culver City, California; for U.S. Department of Transportation, Contract No. T8-233, June 1978.

T63
M2

Maguire, C.E., Inc.

AUTHOR

New Containerization facilities: a feasibility study.

TITLE

DATE DUE	BORROWER'S NAME
3/25/80	A Reilly